

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD. AND SAMSUNG ELECTRONICS
AMERICA, INC.,
Petitioner,

v.

OPTIMUM IMAGING TECHNOLOGIES LLC,
Patent Owner.

Case IPR2025-00628

Patent No. 8,451,339

DECLARATION OF WAYNE PRENTICE

TABLE OF CONTENTS

	Page
I. INTRODUCTION	6
II. BACKGROUND AND QUALIFICATIONS	6
III. MATERIALS REVIEWED.....	10
IV. SUMMARY OF OPINIONS	12
V. UNDERSTANDING OF THE LAW	13
A. Patent Claims; Claim Interpretation	14
B. Level of Ordinary Skill in the Art.....	15
C. Analogous Art.....	16
D. Obviousness of a Patent Claim.	16
VI. THE STATE OF THE ART	19
A. Digital Image Correction In Camera	19
B. In-Camera Hardware For Image Processing and Image Data Storage.....	21
C. Camera System Architecture	29
D. Red Eye Reduction.	34
VII. OVERVIEW OF THE '339 PATENT.....	35
A. Summary	35
B. Prosecution History.....	38
VIII. THE LEVEL OF SKILL OF THE POSA	39

Declaration of Wayne Prentice

U.S. Patent No. 8,451,339

IX. CLAIM CONSTRUCTION	41
X. THE CHALLENGED CLAIMS ARE UNPATENTABLE	42
A. The Prior Art	42
1. Niikawa (Ex-1005).....	42
2. Steinberg (Ex-1028).....	47
B. Claims 6, 7, and 10 would have been obvious over Niikawa and Steinberg ..	50
1. How and why a POSA would combine teachings from Steinberg with Niikawa	50
2. Independent Claim 6	59
3. Claim 7	81
4. Claim 10	82
C. Secondary Considerations of Non-Obviousness	83
XI. CONCLUSION	84

LIST OF CHALLENGED CLAIMS

Identifier	Claim Language
[6pre]	A digital imaging system for correcting image aberrations comprising:
[6A-1]	a digital camera mechanism,
[6A-2]	an optical lens mechanism,
[6A-3]	a digital sensor,
[6A-4]	an integrated circuit,
[6A-5]	a digital signal processor,
[6A-6]	system software,
[6A-7]	a database management system and
[6A-8]	a memory storage sub-system;
[6B]	wherein the optical lens mechanism is a zoom lens or a fixed focal length lens;
[6C]	wherein the image data file is forwarded from the digital sensor to storage in memory;
[6D]	wherein at least one optical and/or digital aberration in the image file are identified by comparing image files in the database management system by using the system software and the integrated circuit;
[6E]	wherein the at least one filtration algorithms required to correct the at least one optical and/or digital aberration are sent from the integrated circuit to the digital signal processor;
[6F]	wherein the at least one optical and/or digital aberration from the optical lens mechanism are corrected by using the digital signal processor to apply digital filtration algorithm; and

Declaration of Wayne Prentice
U.S. Patent No. 8,451,339

[6G]	wherein the modified digital file consisting of the digital data optimized from the at least one aberration that are corrected from the original optical image is stored in memory.
[7]	The system of claim 6: wherein the optical aberrations include spherical, comatic, lens distortion, astigmatism, chromatic aberrations, curvature of field, pin cushion, barrel distortion, scattered light, red eye, dust and/or flare types of optical aberrations.
[10]	The system of claim 6: wherein the digital signal processor applies color filtration to the image file.

I. Introduction

1. My name is Wayne Prentice. I have been retained by counsel for Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. as an expert witness in this *inter partes* review. I have been asked to render an opinion about whether claims 6, 7, and 10 of U.S. Patent No. 8,451,339 (“339 Patent” or “Ex-1001”) would have been obvious over certain prior art references.

2. I have personal knowledge of all the facts set forth herein, and if called to testify at any hearing in this *inter partes* review, I would competently testify and verify the testimony contained herein.

3. I am being compensated at my customary hourly rate. I am also being reimbursed for reasonable out-of-pocket expenses. I do not expect to receive any other compensation based on my work on this matter. My compensation does not depend in any way on the outcome of this proceeding, the opinions I express, or the testimony I give.

4. I expect to be available for deposition upon reasonable notice given.

II. Background and Qualifications

5. My qualifications and professional experience are described in my Curriculum Vitae, a copy of which can be found in Ex-1004. I summarize certain qualifications and professional experience relevant to the issues in this proceeding in the following paragraphs.

6. I received a Bachelor of Science degree in Electrical Engineering from Clarkson University in 1983. From 1983 to June 1995 I worked at GE Healthcare working in the MRI, CT nuclear medicine, and x-ray imaging systems. In 1991, I enrolled in graduate school at Rochester Institute of Technology, where I received an M.S. in Image Science in 1997.

7. In 1995, I joined Eastman Kodak as a senior software engineer, where I was the software architect or lead for various Kodak products, including the Kodak DVC300/323 USB Video Camera.

8. In 1997, I was promoted to the role of Research Engineer, a position that I held until 2008. During that time, I worked on developing new camera technologies and applications of camera technology. In addition to research projects, I also spent time on product development teams commercializing printer and digital camera products. Over this period I designed and implemented image editing processing chains for numerous products and devices; created product code for desktop and firmware platforms; and transitioned prototypes, new products, and services out of research and development and into commercial products. Among other things, I developed the image processing chains including the Kodak EasyShare Software, which was distributed to over 25 million users; invented the “Smart Capture” feature of the Kodak Digital Camera line; acted as Lead Image Scientists for the digital camera feature of the Motorola ZN5; developed algorithms

for exposure, flare, and hue correction used in the Kodak V570, V603, V610, and C875 Digital Cameras; created the Image Capture and Review Mode firmware for the MC3 Digital Multimedia Camera; modeled the CMY sensor design to predict ISO performance in the DCS720x digital camera; and developed image processing firmware for automatically adjusting color and other properties in a printed image (so-called “auto-fix” firmware) for the Kodak Personal Picture Maker 200 Inkjet Printer (“PPM 200”).

9. As part of this work, I designed and implemented auto-exposure, auto-focus, and auto white balance algorithms; developed CMOS sensor models to simulate mobile and full-frame sensor modules to be implemented in actual product design; and developed image processing and computer vision applications.

10. Throughout my career at Kodak and beyond, I routinely addressed the issue of image path optimization, including the correction of aberrations in digital cameras and digital imaging systems. For example, in my work on the Motorola ZN5, which was released in 2008, one of the principal tasks was developing a lens, sensor, and image processing system that adequately compensated for the distortions that resulted from the use of a small, cell phone-type lens and sensor. My work with the Motorola ZN5, and other Kodak products, involved, among other things, evaluating aberrations in digital images and developing means to correct them.

11. In 2008, I was promoted to Kodak's Senior Principal Image Scientist

for Kodak's digital capture products. As Senior Principal Image Scientists I oversaw and supported the activities of twelve image scientists; advanced Kodak's image science capability in consumer devices; and achieved various business deliverables, including in quality testing; image science competency for the development of digital cameras for the consumer and mobile markets; and product planning and commercialization.

12. In 2012, after Kodak filed for Chapter 11 bankruptcy, I left Kodak to join Exelis as Senior Image Scientist, where I worked on space-based imaging systems. After leaving Exelis in September 2016, I joined Entropix LLC to design RF signal processing solutions. In 2018 I left Entropix LLC and formed Prentice Imaging Consulting Services, which was a continuation of consulting work that I had started four years earlier. I currently work for Prentice Imaging Consulting Services as an independent consultant to provide image science support to various projects relating to digital capture and image path optimization. This work includes developing an image distortion correction system to stitch images in real time to provide a panoramic view about an aerial vehicle. This work also involved creating optical modeling and simulation software to represent and image vignetting, lens aberrations, and geometric distortion. These tools were used to create simulated imagery with all of the aberrations that could be used to test prototype image paths.

13. In 2022, I became a counselor in the Rochester IS&T (Image Science

and Technology) professional society where I am currently the recording secretary. As part of this group, I have delivered several talks involving high dynamic range imaging and digital camera concepts.

14. I am listed as an inventor on sixteen U.S. patents. My inventions concern technologies relating to digital cameras, image sensors, image processing, and graphical user interfaces used in connection with image editing, conversion, and correction. These U.S. patents are noted in my Curriculum Vitae.

15. In summary, I have nearly thirty years of experience in image processing, image path optimization, lens aberration correction, and digital camera systems and design. I have practical, hands-on experience with technology that is relevant to the '339 Patent and the references that I have been asked to analyze and I believe I am an expert in the field of the '339 Patent.

16. Additional information concerning my background, qualifications, publications, conferences, honors, and awards are described in my Curriculum Vitae.

III. Materials Reviewed

17. In reaching the conclusions described in this declaration, I have relied on the documents and materials identified in the exhibit list below.

Exhibit	Description
Ex-1001	U.S. Pat. No. 8,451,339 (“’339 Patent”)
Ex-1002	Prosecution History of the ’339 Patent
Ex-1005	U.S. Pat. App. Pub. No. 2002/0135688 (“Niikawa”)
Ex-1014	U.S. Patent No. 9,063,982 (“Bestgen”)

Declaration of Wayne Prentice
U.S. Patent No. 8,451,339

Ex-1015	U.S. Patent No. 6,920,443 (“Cesare”)
Ex-1016	U.S. Pat. No. 7,612,805 (“805 Patent”)
Ex-1021	Certified Translation of Japanese Pat. App. Pub. No. H11-205652 (“Ichiyama”)
Ex-1025	Certified Translation of Ricoh Technical Report No. 31, RICOH (Apr. 20, 2006), https://web.archive.org/web/20060420051054/http://www.ricoh.co.jp/about/business_overview/report/31/ (“Ricoh”)
Ex-1027	U.S. Patent No. 10,873,685 (“685 Patent”)
Ex-1028	U.S. Pat. App. Pub. No. 2005/0041121 (“Steinberg”)
Ex-1029	Certified Translation of Japanese Patent App. Pub. No. 2003-158672 (“Endo”)
Ex-1032	Greg Linden & Deepak Somaya, <i>System-on-a-chip integration in the semiconductor industry: industry structure and firm strategies</i> , Industrial and Corporate Change, pp.545-576.
Ex-1033	U.S. Patent No. 7,352,394 to DeLuca et al.
Ex-1034	Gordon E. Moore, <i>Cramming More Components onto Integrated Circuits</i> , Proc. Of IEEE, Vol. 86, No. 1 (Jan. 1998) (reprinted from Gordon E. Moore, <i>Cramming More Components onto Integrated Circuits, Electronics</i> , pp.114-117 (Apr. 19, 1965)).
Ex-1036	U.S. Patent Application Publication No. 2004/0252217 A1 to Battles et al.
Ex-1037	U.S. Patent Application Publication No. 2008/0192129 A1 to Walker et al.
Ex-1038	M.B. Sandler, et al., <i>A Comparative Evaluation of DSPs, Microprocessors, and the Transputer for Image Processing</i> , Int’l Conf. on Acoustics, Speech, and Signal Processing, pp. 1532-1539 (IEEE, May 23, 1989).
Ex-1039	U.S. Patent No. 6,407,777 to DeLuca et al.
Ex-1040	Xiao-Ping Maio, et al., <i>Automatic Red-eye Detection and Removal</i> , IEEE Int’l Conference on Multimedia and Expo (ICME) (IEEE Cat No. 04TH8763), pp.1195-1198 (Jun. 27, 2004)
Ex-1041	Lei Zhang, et al., <i>Automated Red-Eye Detection and Correction in Digital Photographs</i> , 2004 Int’l Conference on Image Processing, ICIP’04, Vol. 4, pp.2363-2366 (Oct. 24, 2004)
Ex-1042	U.S. Patent No. 6,016,354 to Lin et al
Ex-1043	U.S. Patent No. 7,042,505 to DeLuca

Ex-1044	U.S. Pat. App. Pub. No. 2006/0274185 to Safai
Ex-1045	U.S. Patent No. 7,107,516 to Anderson, et al.
Ex-1046	U.S. Pat. App. Pub. No. 2003/0151679 to Amerson et al.
Ex-1047	U.S. Pat. App. Pub. No. 2005/0286097 to Hung et al.
Ex-1048	U.S. Pat. App. Pub. No. 2008/0192129 to Walker et al.
Ex-1049	U.S. Pat. App. Pub. No. 2002/0186412 to Murashita
Ex-1050	TMS320DSC21 – A High Performance, Programmable, Single Chip Digital Signal Processing Solution to Digital Still Cameras, DSC Business Unit, Texas Instruments (2005)
Ex-1051	TI and Kodak – Working Together to Bring Superior Digital Camera Products to Market

IV. Summary of Opinions

18. The following paragraphs summarize the key opinions I provide in this Declaration. It is not my intent to provide an exhaustive list or recitation of all aspects of my opinions in this section. A full discussion of the reasons for my opinions is provided in detail later in this Declaration.

19. For ease of reference, I will refer to the claim limitations using the nomenclature provided by counsel in the Petition, which are reproduced in the table above.

20. I was asked to assume that the claims of the '339 Patent were invented on July 11, 2006. I made that assumption in rendering my opinions. I applied the legal guidance about how to assess the knowledge held by a person of ordinary skill in the art ("POSA") that I received from counsel. Based on that legal guidance, the '339 Patent, the prior art, and my experience in the digital imaging field, it is my opinion that a POSA would have had a Bachelor of Science degree in electrical

engineering, physics, or a related field, with at least two years of industry experience or research relating to digital camera system design and image processing on July 11, 2006. This person would have had a working understanding of various design options that were available in designing a digital imaging system with aberration correction and would have known how to implement these various options in a working system. I provide further details about my opinion below.

21. I was also provided legal guidance on what makes a prior art reference “analogous.” I applied that legal guidance (summarized below) and it is my opinion that both Niikawa and Steinberg are analogous art to the ’339 Patent because Steinberg and Niikawa are in the same field as the ’339 Patent and they are reasonably pertinent to a problem faced by the inventor of the ’339 Patent based on its specification. I provide further details about my opinion below.

22. I was also provided guidance on the law of obviousness, which I understand is a legal conclusion based on various underlying factual considerations. Based on this guidance, it is my opinion that what is claimed in claims 6, 7, and 10 of the ’339 Patent would have been obvious to a POSA over Niikawa in view of Steinberg. I provide the details of my analysis that leads me to this conclusion below.

V. Understanding of the Law

23. I do not expect to offer any opinions on the law because I am not a lawyer. My understanding of the legal standards to apply in reaching the conclusions

in this declaration is based on instructions about the law provided by counsel for Petitioner. In preparing this declaration, I have tried to faithfully apply the legal standards when formulating my opinions.

A. Patent Claims; Claim Interpretation

24. I understand that the numbered sentences at the end of the '339 Patent are called "claims." There are two types of claims in the '339 Patent: independent claims and dependent claims. I have been informed that an independent claim does not refer to any other claims. I have been informed that a dependent claim is a patent claim that refers to another patent claim and includes all the limitations of the claim to which it refers.

25. I understand that the words of the claim generally carry their plain and ordinary meaning as would be understood by a POSA based on a review of the description and prosecution history as of July 11, 2006 (in this case). The context provided by the patent's description, other claims, and prosecution history is the best indication of the meaning of the words of the claims. I have been informed that I can consult sources other than the description, other claims, and prosecution history to evaluate the meaning of the words of the claims. In doing so, I've been told that it is important to ensure that any meaning I may glean from these other sources does not contradict what the intrinsic evidence suggests about the meaning of the claim language.

26. I have been further informed that the specification or prosecution history may define a claim term. If that happens, I am to apply the definition provided by the patent applicant in my understanding of the claim language. Additionally, I have been informed that there may be instances in which a patent applicant disclaims a particular meaning of a claim phrase or word. If I see such a disclaimer, I was instructed that I am not supposed to allow the claim to extend to cover the disclaimed subject matter.

B. Level of Ordinary Skill in the Art

27. I mentioned the POSA above. I understand and have been informed that a POSA is not a real person, but instead is a hypothetical construct that is used to evaluate things like the meaning of the patent claims and the question of obviousness. I have been informed that a POSA can be thought of as a person that has all relevant and available prior art at their disposal and brings to bear their education and skills when evaluating the prior art. I have been informed that I should envision a person sitting in a workshop with walls covered with all of the prior art when I evaluate obviousness.

28. I have been given guidance about how to evaluate the skill set and knowledge that the hypothetical POSA would have. For instance, I have been asked to consider the following factors in formulating my opinion:

- the type of problems encountered in the art or field of invention,

- prior art solutions to those problems,
- the rapidity with which innovations are made,
- sophistication of the technology, and
- the educational level of active workers in the field.

29. I provide my opinion on the qualifications and skills of a POSA below.

C. Analogous Art.

30. I understand and have been informed that a prior art reference is only relevant in assessing the obviousness of a patent claim if it is “analogous art.” I have been informed and understand that a reference is analogous art if it is (1) from the same field of endeavor as the claimed invention; or (2) it is reasonably pertinent to the problem faced by the inventor.

D. Obviousness of a Patent Claim.

31. I understand that a claim may be invalid if the subject matter described by the claim as a whole would have been obvious to a POSA in view of a prior art reference, or in view of a combination of references at the time the claimed invention was made. Therefore, I understand that obviousness is determined from the perspective of a POSA.

32. I also understand that an analysis of whether a claimed invention would have been obvious should be considered in light of the scope and content of the prior art, the differences (if any) between the prior art and the claimed invention, and the level of ordinary skill in the pertinent art involved. I understand as well that a prior

art reference should be viewed as a whole. I understand that in considering whether an invention for a claimed combination would have been obvious, I may assess whether there are apparent reasons to combine known elements in the prior art in the manner claimed in view of interrelated teachings of multiple prior art references, the effects of demands known to the design community or present in the marketplace, and/or the background knowledge possessed by a POSA. I also understand that other principles may be relied on in evaluating whether a claimed invention would have been obvious, and that these principles include the following:

- A combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results;
- When a device or technology is available in one field of endeavor, design incentives, and other market forces can prompt variations of it, either in the same field or in a different one, so that if a POSA can implement a predictable variation, the variation is likely obvious;
- If a technique has been used to improve one device, and a POSA would have recognized that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill;
- An explicit or implicit teaching, suggestion, or motivation to combine two prior art references to form the claimed combination may demonstrate obviousness, but proof of obviousness does not depend on or require showing a teaching, suggestion, or motivation to combine;
- Market demand, rather than scientific literature, can drive design trends and may show obviousness;
- One of the ways in which a patent's subject can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims;

- Any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed;
- “Common sense” teaches that familiar items may have obvious uses beyond their primary purposes, and in many cases a POSA will be able to fit the teachings of multiple patents together like pieces of a puzzle;
- A POSA is also a person of ordinary creativity, not an automaton;
- A patent claim can be proved obvious by showing that the claimed combination of elements was “obvious to try,” particularly when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions such that a POSA would have had good reason to pursue the known options within his or her technical grasp; and
- One should be cautious of using hindsight in evaluating whether a claimed invention would have been obvious.

33. I understand that a POSA is a person of ordinary creativity, but not an automaton, and that a POSA can often fit multiple patents or prior art references together like pieces of a puzzle as a result of this ordinary creativity. I also understand that I may consider the inferences and creative steps that a POSA would employ. In addition, I understand that a POSA would necessarily have been capable of understanding the scientific and engineering principles applicable to the pertinent art. I also understand that when I consider what would have been obvious to a POSA, I am not considering what would have been obvious to me at the time, nor to the inventors, judges, laymen, those skilled in other arts, or to geniuses in the art.

34. I have been informed that the relevant time for considering whether a claim would have been obvious to a person of ordinary skill in the art is the time of

invention. As described above, for my obviousness analysis, counsel for Petitioner instructed me to assume that is the time of the invention was July 11, 2006

VI. The State of the Art

35. In this section I summarize some of the information that a POSA would have brought to bear when considering the Niikawa and Steinberg.

A. Digital Image Correction In Camera

36. The '339 Patent mentions available post-production editing software solutions to improve images, such as Photoshop. '339 Patent, 6:31-37, 12:66-13:3. The '339 Patent states that the invention sought to improve on such solutions by applying image corrections in the camera itself. *Id.*, 12:66-13:3. A POSA would have been familiar with various techniques that applied aberration correction within digital cameras using a range of techniques employing both software and hardware as I explain below.

37. One company involved in the development of digital cameras around July 2006 was Ricoh. *See* Guan, et al., *Digital Image Correcting Method for Digital Camera*, Ricoh Technical Report No. 31 (Dec. 2005) (Ex-1025) (“Ricoh Technical Report”). The Ricoh Technical Report explains that when digital cameras use zoom lenses, “much more distortion and chromatic aberration” appear in the resulting images than when using a standard lens. *Id.*, pg. 103. The Ricoh Technical Report explains that Ricoh had developed a way to apply various aberration corrections “by

image processing software embedded in the digital camera.” *Id.* Various algorithms for correcting image aberration are explained. “Testing was carried out by installing [the] algorithm in a camera unit.” *Id.*, pg. 107. Among the aberrations being corrected is peripheral shading. *Id.*, pgs. 108-109.

38. Others working in the field of digital imaging and cameras were also focused on ways to correct for aberrations in images. For example, an “Unexamined Patent Publication” to an applicant named Yoshikazu Ichiyama describes a way to remedy chromatic aberration and pixel defects in image sensors. *See* JPH11-205652 (“Ichiyama”) (Ex-1021). The camera is used to capture an image of a “calibration graphic,” and that calibration graphic is used to calculate “a correction function,” which is then applied to digital images that are captured by the camera. *Id.*, Abstract & [005]. “In addition to image distortion, chromatic aberration in the optical imaging system and errors in the color conversion function of the image sensor can also be targeted for correction.” *Id.*, ¶[008]. Ichiyama describes the technique in part as follows:

Figure 2 shows a functional block diagram of a digital camera in the first embodiment of the present invention. In the first embodiment, an image of a predetermined calibration graphic is captured as a photographic subject in a calibration mode. Meanwhile, a proper, correct image of the

calibration graphic is stored separately in a memory inside the digital camera, and a function mapping between pixels is derived as a correction function from the relationship of said image to the proper image, that is, to an ideal image. In other words, the location for correct positioning of individual pixels forming a captured image is determined, and the relationship that indicates this is the correction function. The objective during normal photography is to use the correction function to map and thus move the pixels of the captured image to obtain a correct image.

Id., ¶[012].

B. In-Camera Hardware For Image Processing and Image Data Storage

39. In this section I describe certain known camera hardware and its applications in digital cameras with a particular focus on some hardware found in claim 6 and its dependent claims: “an integrated circuit” (which can be a “microprocessor,” or “application specific integrated circuit,” or “system on a chip”) and a “digital signal processor.” ’339 Patent, claims 6 & 12. A POSA would have known that a digital signal processor was abbreviated “DSP” and an application specific integrated circuit is also referred to as an “ASIC.” I use these abbreviations in my discussion below.

40. A POSA would have known that integrated circuits (such as microprocessors), DSPs and ASICs were choices available to the POSA for processing data in digital cameras. A POSA knew that one could substitute for another easily and with predictable results. The following examples of patent literature show that a POSA would have known about the substitutability of these various hardware components in the context of digital cameras and other imaging systems:

- **U.S. Patent No. 7,042,505 to DeLuca (Ex-1043):** Describes a red eye reduction technique for a digital camera and states: “It can be appreciated that many of the processes implemented in the digital camera may be implemented in or controlled by software operating in a microcomputer (μ C) or digital signal processor (DSP) and/or an application specific integrated circuit (ASIC).” DeLuca, 2:66-3:4; see *also id.*, 2:7-8 (“Digital cameras include microprocessors . . .”).
- **U.S. Patent Application Publication No. 2006/0274185 to Safai (Ex-1044):** Describes a digital image processor for a digital camera that includes both a preprocessor and a postprocessor. Safai, Abstract. Safai says: “Typically, the integrated circuit in which the digital processor 400 is formed is an application specific integrated circuit (ASIC) having various functional blocks and memory blocks included therein.

However, in alternative embodiments it may be implemented in *any suitable form including software and programmable logic and combinations of forms.*” Safai, ¶[0054] (emphasis added). When a programmable microprocessor is used—thus making the “image process controller 310” programmable—this can “significantly reduce development time and costs, as well as component costs since specific ASICs are no longer necessary. Safai, ¶[0061]; *see also id.*, ¶¶[0051]-[0052] (explaining use of microprocessor with digital image processor 310).

- **U.S. Patent No. 7,107,516 to Anderson, et al. (Ex-1045):** Describes a system for viewing images from an image capture device (such as a digital camera) on a host computer. In describing the digital camera of FIG. 7, Anderson explains that: “CPU 344 may include a conventional microprocessor device for controlling the operation of the camera 110,” but “[A]lthough CPU 344 is preferably a microprocessor, one or more DSP’s (digital signal processor) or ASIC’s (Application Specific Integrated Circuit) could also be used.” Anderson, 8:42-57.
- **U.S. Patent Application Publication No. 2003/0151679 to Amerson et al. (Ex-1046).** Describes a way to use multiple images to improve a final image in a digital camera. Amerson, ¶[0001]. Amerson explains

that the disclosed system:

can be implemented in hardware, software, firmware, or a combination thereof. In the preferred embodiment(s) of the invention, the invention is implemented using a combination of hardware and software or firmware that is stored in memory that is executed by a suitable instruction execution system. The hardware portion of the invention can be implemented with any or a combination of the following technologies, which are all well known in the art: a discrete logic circuit(s) having logic gates for implementing logic functions upon data signals, an application specific integrated circuit (ASIC) having appropriate combinational logic gates, a programmable gate array(s) (PGA), a field programmable gate array (FPGA), etc. Software or firmware could be implemented in a microprocessor, digital signal processor (DSP), reduced instruction set computer (RISC), or special purpose programmable processor.

Amerson, ¶[0018].

- **U.S. Patent Application Publication No. 2005/0286097 to Hung et al. (Ex-1047).** Describes an automatic white balance correction for captured images that can be used in an image capture device (*e.g.*, FIG.

1). Hung, Abstract, ¶[0023], FIG. 1. Hung conveys that the selection of the appropriate hardware to perform certain image processing tasks was known to a POSA and various options were available for use:

The various illustrative logical blocks, modules, and circuits described in connection with the embodiments disclosed herein may be implemented or performed with a general purpose processor, a digital signal processor (DSP), a Reduced Instruction Set Computer (RISC) processor, an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general purpose processor may be a microprocessor, but in the alternative, the processor may be any processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, for example, a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

Hung, ¶[0086].

- **Japanese Patent App. Pub. No. 2003-158672 to Endo (Ex-1029):**

Discloses an “ASIC that functions as an image processing circuit.”
Endo, ¶[0023]; *see also id.*, ¶¶[Abstract], [0027], [0029]-[0032],
[0045], Figs. 1, 2 (showing an ASIC and CPU for correcting
aberrations).

- **U.S. Patent Application Publication No. 2004/0252217 to Battles**

(Ex-1036): Discloses that the ASIC controls the function of various
aspects of a digital camera, and may execute, for example, image
analysis logic. Battles, ¶[0014]; *see also id.* (“[W]hile illustrated using
a single ASIC 102, the digital camera 100 may include additional
processors, digital signal processors (DSPs) and ASICs.”).

41. These disclosures confirm what those working on digital camera design
knew even after a short while designing such cameras: various hardware such as
DSPs, ASICs, and microprocessors (among others) were available to perform
various functions on image data in digital cameras. The implementation choice was
up to the designer and, as I explain in further detail below, the reasons that a POSA
might select a particular option over another had well-understood consequences and
yielded predictable results.

42. Another technique that is germane to claims 6, 7, and 10 of the '339
Patent is the storage of images for later use within the device. Specifically, claim 6

of the '339 Patent says, “wherein at least one optical and/or digital aberration in the image file are identified by comparing image files in the database management system by using the system software and the integrated circuit.” ’339 Patent, claim 6. Storing image files in a database management system was a known technique for storing image files in digital cameras and digital imaging systems. For example, the following patent literature illustrates the knowledge a POSA would have had regarding the storage of image files in digital cameras:

- **U.S. Patent Application Publication No. 2008/0192129 to Walker et al. (Ex-1037).** Walker describes an example of a camera in connection with FIG. 6A. Walker, ¶¶[0132]-[0144]. FIG. 6A is reproduced below.

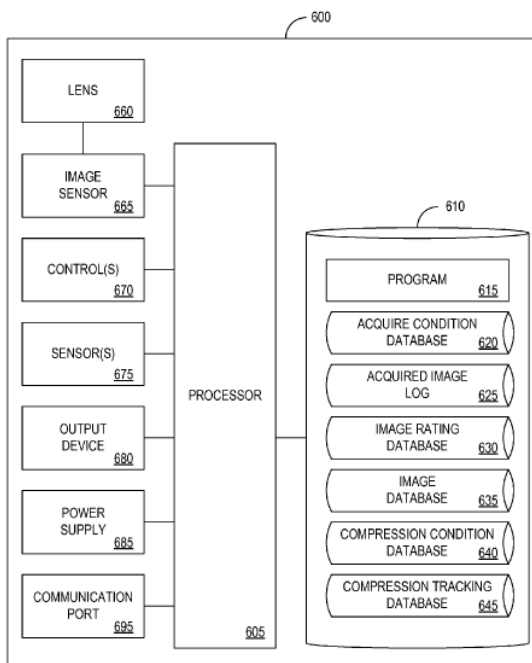
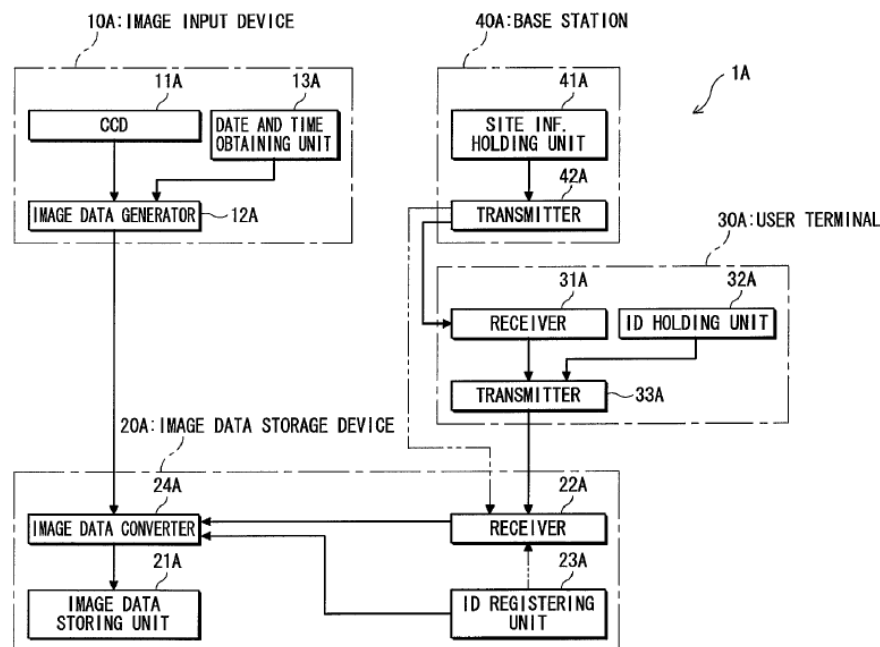


FIG. 6A

Walker’s FIG. 6A shows an “image database 635” that is “for storing

images.” *Id.*, ¶¶[0133], [0147].

- **U.S. Patent Application Publication No. 2002/0186412 to Murashita (Ex-1049).** Murashita describes a system for facilitating “management and classification of image data obtained by a digital camera.” Murashita, Abstract. This allows users to manage and classify image data based on the place where the image was captured (e.g., using GPS data associated with the capture of an image). *Id.*, ¶¶[0002], [0033], [0040]-[0041]. Image databases can be created based on subject matter. *Id.*, ¶[0057]. Murashita’s FIG. 1 shows an “image input device” 10A and an “image data storage device” 20A (see below).



In this figure, the image storage device is shown as being separate from

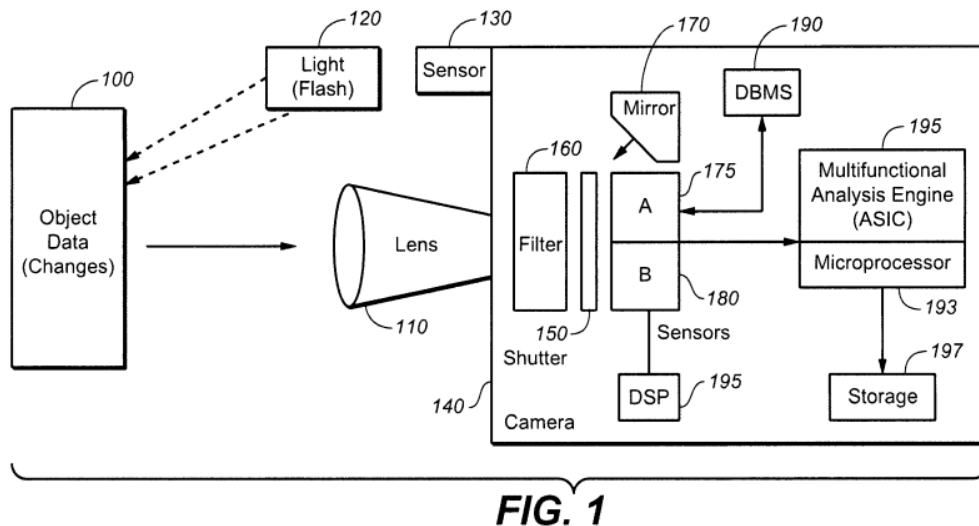
the image input device (which has a sensor (CCD) to capture images).

But, Murashita also says that “[d]igital camera 10A and image data storage device 20A can be integrated instead, thereby providing digital camera 10A with the function of image data storage device 20A (the functions of image data storing unit 21A, receiver 22A, ID registering unit 23A, and image data converter 24A).” Murashita, ¶[0130]; *see also id.*, ¶[0170] (same for a second embodiment).

C. Camera System Architecture

43. Digital camera system architecture is an example of an embedded system where the system computing needs are done on the device. The ’339 Patent describes such a system. *See, e.g.*, ’339 Patent at 6:54-54 (“What is needed to correct these various optical and digital aberrations and unfiltered image files is in-camera modification capability for each specific image problem.”).

44. The ’339 Patent further depicts a system containing multiple computing elements, including an ASIC, microprocessor, and DSP.



'339 Patent at FIG. 1.

45. Such elements were typically found in digital cameras in the marketplace. For example, a press release (Ex-1051) describes three Kodak cameras from 2001 employing the Texas Instruments ("TI") TMS320DSC21 chip. The TMS320DSC21 chip as, described in a 2005 TI White Paper (Ex-1050) contains a DSP, ARM7 microprocessor, and dedicated hardware for image processing.

Functional Block Diagram of the TMS320DSC21

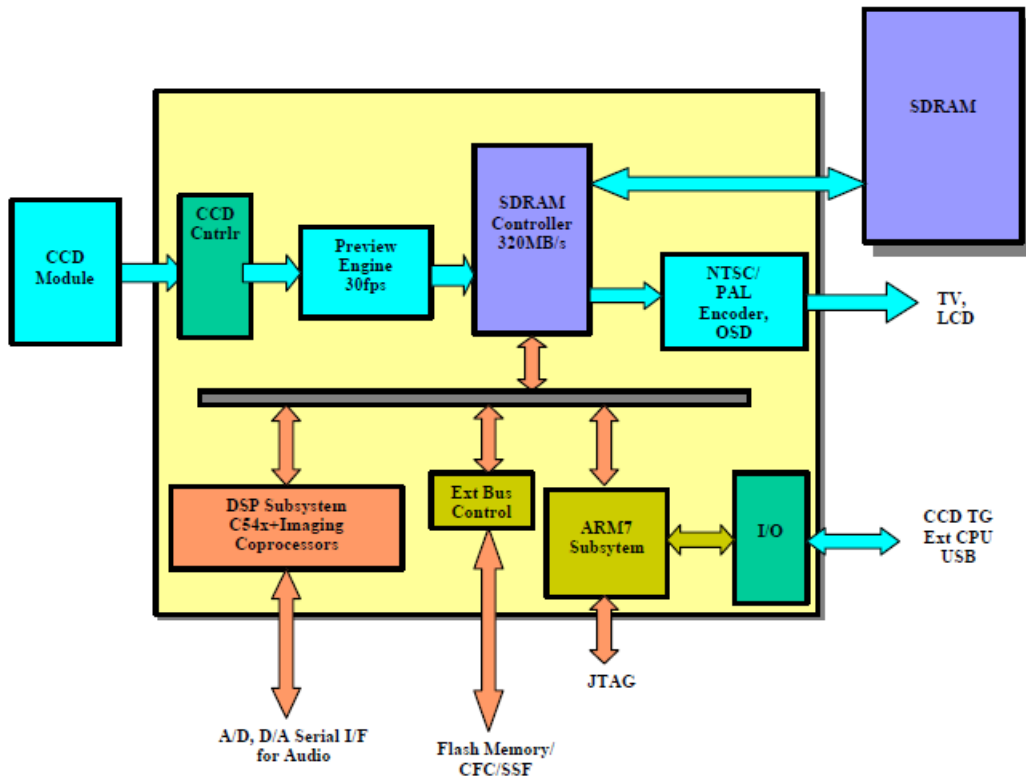


Figure 5 DSC21 System Architecture

TI White Paper at Fig. 5.

46. The image processing pathway of the TMS320DSC21 chip is depicted in Figure 4:

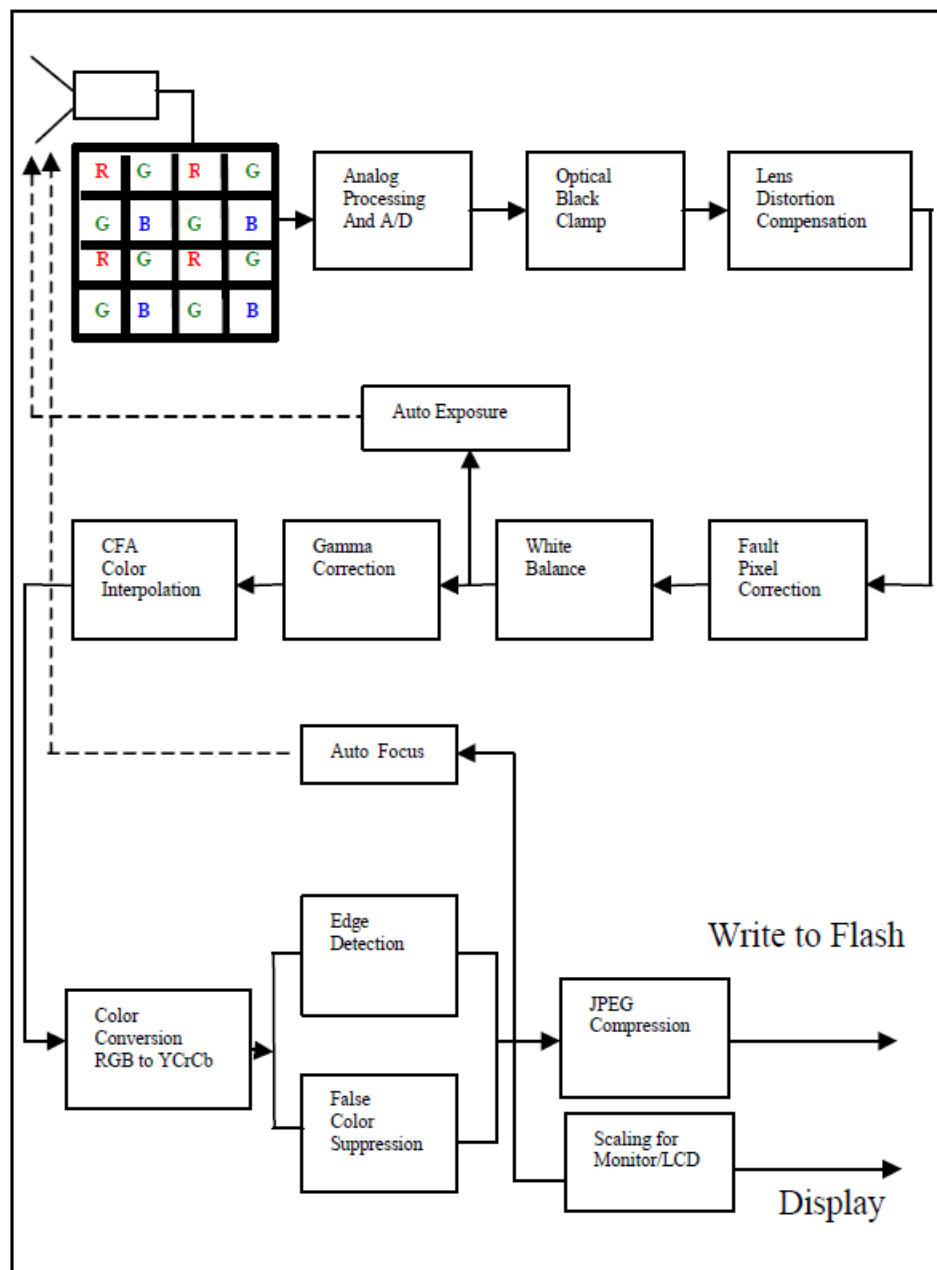


Figure 4 A Typical DSC Image Capture Pipeline

Id. at Fig. 4.

47. The image processing pathway depicted in Figure 4 shows, among other things, an optical correction (“Lens Distortion Compensation”) and a digital

correction (“Fault Pixel Correction”). *Id.* The TI White Paper discloses that the image processing steps were performed using the DSP. *Id.* at 4 (“The DSP subsystem in TMS320DSC21 is well suited to perform these tasks efficiently and generate a high quality image that is close to image quality offered by traditional film from the raw CCD data”).

48. A POSA would have been familiar with embedded software and associated programming systems, including DSPs and microprocessors. A POSA would have known that a DSP is not designed for general purpose computing. Rather, it is designed to efficiently compute numerical functions and thus has specific use cases. In contrast, a POSA would have understood that a microprocessor is usually used for general computing and controls other computing elements. When the DSP has a numerical task to perform, the microprocessor may copy code to the DSP program memory for execution by the DSP.

49. When I worked at Kodak, I was aware that shading correction and other image processing functions were performed in-camera, including in our own cameras. I was also aware that Kodak cameras were using the TMS320DSC21 chip. Publications such as the press release and TI White Paper referenced above (Ex-1051, Ex-1050) were common industry publications of the type that a POSA would have read. For example, a POSA interested in current technology trends and new products visited websites like EE Times, DP Review, or Imaging Resource, all of

which had articles featuring the TMS320DSC21. A POSA interested in this trend would likely visit the TI website in order to learn more about the TMS320DSC21, which would include press releases (such as Ex-1051) and would inform the industry of new publications and collaborations.

50. Publications such as the press release and TI White Paper referenced above (Ex-1051, Ex-1050), both published by TI, would have been trusted by a POSA as accurate and reliable. Indeed, had I been tasked with implementing the alleged invention of the '339 Patent in 2006, the TI White Paper (Ex-1050) was precisely the type of publication I, or any other POSA, would have sought out for more information.

D. Red Eye Reduction.

51. It was commonly known among those in the field—and even to lay-people—that a camera’s flash can result in a phenomenon called “red eye” in an image. This was true in both film and digital cameras. This phenomenon occurs when the camera’s flash is “reflected within a subject’s eye and appears in a photograph as a red dot where the black pupil of the subject’s eye would normally appear.” Steinberg (Ex-1028), ¶[0003]. This leads to “unnatural glowing . . . due to internal reflections from the vascular membrane behind the retina, which is rich in blood vessels.” *Id.* This was regarded as a “very common problem . . . which can ruin a good photo by introducing color aberration into the subject’s eyes.” *See* Xiao-

Ping Maio, et al., *Automatic Red-eye Detection and Removal*, IEEE Int'l Conference on Multimedia and Expo (ICME) (IEEE Cat No. 04TH8763), pp.1195-1198 (Jun. 27, 2004) ("Maio") (Ex-1040); *see also* Lei Zhang, et al., *Automated Red-Eye Detection and Correction in Digital Photographs*, (Ex-1041), 2004 Int'l Conference on Image Processing, ICIP'04, Vol. 4, pp.2363-2366 (Oct. 24, 2004).

52. Techniques for red eye reduction included hardware approaches such as to increase the distance between the flash and the optical axis of the lens and using a pre-flash. *See* Maio, p.1. The use of the pre-flash "only reduces red eye, but does not completely eliminate it," and can reduce battery life. *Id.* Using multiple flashes also can cause confusion among subjects being photographed, who might move once they see the first flash. *See, e.g.*, U.S. Pat. No. 6,016,354 to Lin et al., (Ex-1042), 1:26-42.

53. A POSA would also have been aware of software solutions to correct red eye, such as those disclosed in Steinberg (discussed in detail below), Maio, Lin, and Zhang. If a flash camera did not have a technique for reducing or eliminating red eye, a POSA would have sought to add one because it was such a well-known problem in flash photography.

VII. Overview of the '339 Patent

A. Summary

54. The "Background of the Invention" section of the "'339 Patent

summarizes certain advances in the art through “the twentieth century,” and over “the last twenty-five years.” ’339 Patent, 1:37-3:11. Such advances include autofocus, autoexposure, improvements in zoom lenses, improvements in digital sensors, and the correction of digital artifacts in images. *Id.* The ’339 Patent then explains in a circular fashion: “without new improvements . . . further progression . . . will be limited.” ’339 Patent, 3:10-12. The ’339 Patent states:

Though every major advance in photography has solved an important problem, there are still remaining photographic problems to be solved in order to meet the goals of optimizing optical imaging quality while increasing simplicity and efficiency and lowering cost. Despite the advent and evolution of digital imaging, a number of problems have emerged in the digital realm in addition to earlier problems involving optics. Nevertheless, an opportunity exists to solve some of these problems via digital approaches. These problems are generally categorized as optical or digital.

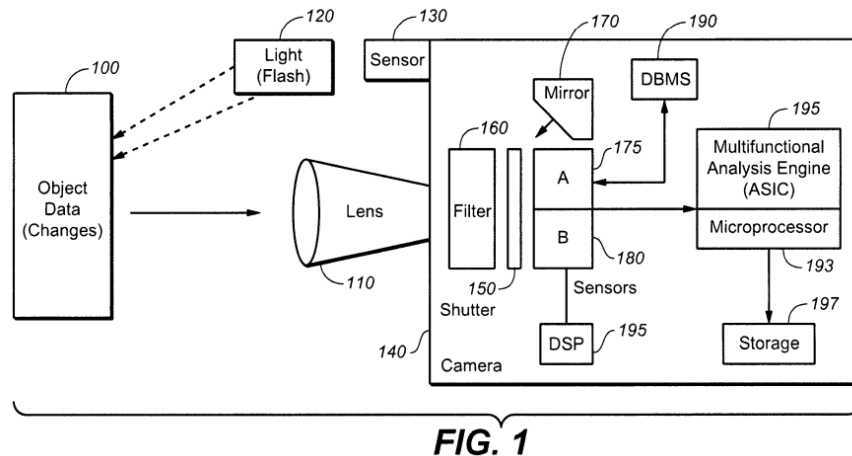
’339 Patent, 3:14-23.

55. In terms of optical problems, the ’339 Patent explains that with improved lens technologies, certain aberrations become more pronounced and difficult to correct. ’339 Patent, 3:24-4:38. With respect to digital imaging, problems include the need to improve color and exposure and contrast range. *Id.*, 6:18-26.

Another issue with digital sensors, according to the '339 Patent, is dust. *Id.*, 6:44-46.

56. The '339 Patent sets forth some alleged benefits of the invention including (1) improving image quality, (2) eliminating or reducing the need for post-production processing, (3) using digital filters instead of optical filters, (4) allowing wider lens apertures, and (5) enabling the design of smaller lenses. '339 Patent, 7:14-49. According to the '339 Patent, it provides “in-camera digital corrections to both optical and digital aberrations.” *Id.*, 8:3-4.

57. FIG. 1 shows “the overall structure” of the disclosed system.



58. As is the case with conventional digital cameras, this system includes a lens 110 that provides light to digital sensors 175, 180. '339 Patent, 30:45-47. A digital signal processor (195) is connected to one or more of the sensors. *Id.*, 30:51-52. The sensors are also connected to an “ASIC (195) and/or a microprocessor (193) in order to process the image and control the camera. The digital image data is passed

form the digital sensor to either the ASIC or microprocessor and then stored in memory.” *Id.*, 30:55-57. According to the ’339 Patent, the invention can be applied to a “system on a chip (SoC)” “in a single microelectronic integrated circuit.” *Id.*, 31:4-7. A database (referred to in FIG. 1 as a “DBMS”) is coupled to the sensor too. *Id.*, 30:52-53.

59. The DSP performs digital filtration by applying software “in order to attain specific aberration corrections.” ’339 Patent, 31:55-57. “Digital filtration is typically performed by the DSP after the image is captured and before the image file is stored.” *Id.*, 32:6-8. Multiple filtration techniques can be performed either sequentially or simultaneously. *Id.*, 32:31-34.

B. Prosecution History

60. I have reviewed the prosecution history of the ’339 Patent. For the purposes of my summary, I focus on statements made by the applicant to the Patent Office. The applicant “acknowledged that microprocessors and ASICs are used in digital cameras,” and that they have “evolved to be applied to embedded computing devices including digital cameras.” File History (Ex-1002), pg. 120. According to the applicant, “[t]he microprocessor is a CPU that controls the computing functions of the camera,” and may use various memory circuits “to store and access data to perform a set of control functions.” *Id.* The applicant further conceded that “it is recognized that a digital signal processor (DSP), typically an application specific

integrated circuit (ASIC), is used to process a digital image file,” and that things like exposure data “is processed using the DSP.” *Id.*, pg. 121. “A DSP may be used to process these digital filter components in order to eliminate digital or color artifacts related to specific image sensor pixels.” *Id.*, pg. 121. According to applicant, “these digital circuitry components are generally accepted to be used in a digital camera.” *Id.*, pg. 121. These statements are consistent with my explanation about camera hardware including microprocessors, ASICs, and DSPs above. *Supra* § VI.B.

61. My review of the file history revealed that neither Niikawa nor Steinberg were discussed during prosecution of the '339 Patent.

VIII. The Level of Skill of the POSA

62. As discussed above, I was instructed about the legal standard for evaluating the qualifications of a POSA. I can consider the problems encountered in the art, the prior art solutions to those problems, the rapidity with innovations are made, the sophistication of the technology, and the education level of active workers in the field. The '339 Patent describes its “field” in the following paragraph:

The present invention pertains to imaging systems.
The invention presents electronic methods to optimize optical processing, the digital capture of light and post-capture image organization of digital data sets. The system may be used in any device that captures, records, replicates, scans, reproduces,

accesses, organizes, modifies, edits or stores images digitally. The invention applies to any imaging system that includes interaction between optics, digital image sensors, post-capture integrated circuits and digital storage components. The system includes self-organizing apparatus for optical image collection, electronic organization and optimization of digital data using integrated circuits and software applications. The system applies to consumer and professional still and video photography, including cinematography, to the processing of images with digital sensors, and to copying and scanning technologies. The system also applies to complex grids of multiple video cameras and satellites for surveillance and reconnaissance.

'339 Patent, 1:16-33 ("FIELD OF THE INVENTION" section).

63. Based on the state of the art, including the materials I summarize above, my review of the '339 Patent, and my own experience working for decades in the digital imaging industry, it is my opinion a POSA would have had a Bachelor of Science degree in electrical engineering, physics, or a related field, with at least two years of industry experience or research, both concerning digital camera system design and image processing at the time the claimed invention was made. Such a person would have been aware of techniques to improve digital image quality using

various software and hardware techniques and would have been aware of the use of microprocessors, integrated circuits, application specific integrated circuits, and digital signal processors in digital camera design and implementation.

IX. Claim Construction

64. For the purpose of this declaration, I have been instructed to construe the phrase “from the integrated circuit to the digital signal processor” in claim 6 of the ’339 Patent to allow for sending the claimed at least one filtration algorithm from one part of the integrated circuit to another part of an integrated circuit that is a digital signal processor.

65. I have also been instructed to construe the phrase “wherein the optical aberrations include spherical, comatic, lens distortion, astigmatism, chromatic aberrations, curvature of field, pin cushion, barrel distortion, scattered light, red eye, dust and/or flare types of optical aberrations” from claim 7 of the ’339 Patent to require any one or more of the listed “optical aberrations.”

66. I understand that Petitioner applies these constructions for the purposes of this Petition. I express no opinion on these constructions, but I have applied them.

67. I have been instructed that all other claim terms should be given their ordinary meaning to a POSA.

X. The Challenged Claims Are Unpatentable

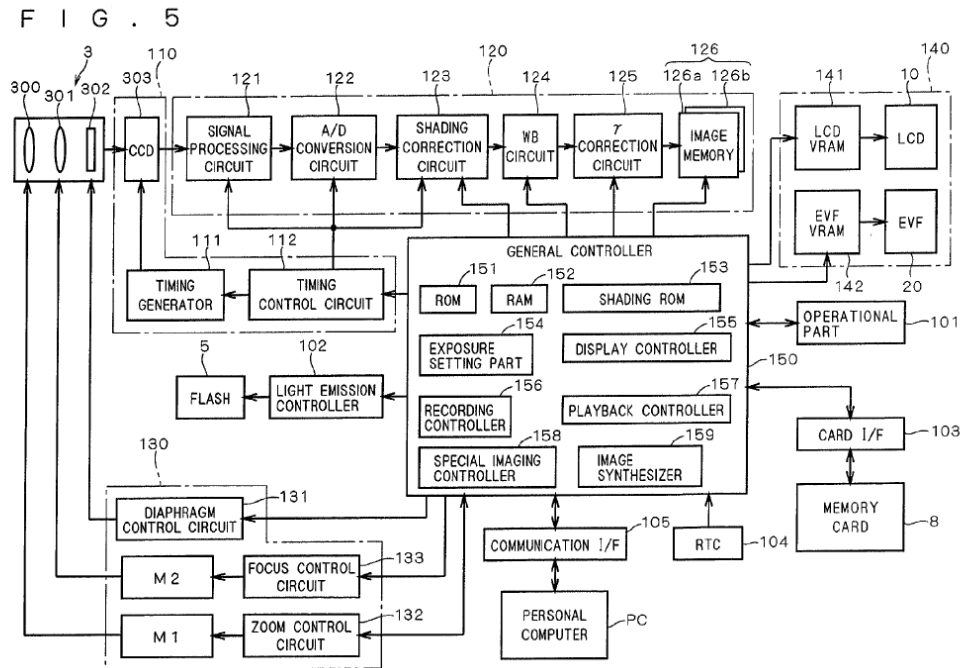
A. The Prior Art

68. Below I summarize patent literature from Niikawa and Steinberg. I have been asked to assume that both Niikawa and Steinberg are prior art. In the following subsections I describe relevant aspects of the description from Niikawa and Steinberg. I also explain why Niikawa and Steinberg are analogous prior art to the '339 Patent.

1. Niikawa (Ex-1005)

69. Like the '339 Patent, Niikawa describes a digital camera that includes a lens 3, a CCD sensor 303, and that has internal circuitry and software to correct for aberrations in digital images (called “shading”). *E.g.*, Niikawa, Abstract, ¶[0067]; FIG. 5.

70. One example of an implementation of Niikawa’s digital camera is shown in Figure 5:



71. Images are captured by CCD 303 and then they are digitized. After the image data is digitized, it is processed in signal processor 120. Niikawa, ¶¶[0077]-[0079]. The images are stored in image memory 126 after they are processed by signal processor 120. *Id.*, ¶[0087].

72. Specifically, Niikawa discloses:

An image capturer 110 photoelectrically converts a subject light source entered via the imaging lens 3 into an image signal and captures the image signal, and is provided with a timing generator 111 and a timing control circuit 112 as well as the CCD 303. The CCD 303 receives the light of the subject light source for a predetermined exposure time based on a drive control signal inputted from the timing

generator 111 to convert it to an image signal, and outputs the image signal to a signal processor 120 by using a readout control signal inputted from the timing generator. At this time, the image signal is outputted to the signal processor 120 while being divided into each of the color components R, G and B.

Niikawa, ¶[0077].

The signal processor 120 executes a predetermined analogue signal processing and digital signal processing with respect to an image signal outputted from the CCD 303. The signal processing of image signal is executed for every light reception signal of each pixel constituting the image data. The signal processor 120 has the signal processing circuit 121, the A/D conversion circuit 122, the shading correction circuit 123, an WB circuit 124, a γ correction circuit 125 and an image memory 126.

Id., ¶[0079].

73. Niikawa's camera includes a "general controller 150" that includes, among other things, a ROM 151 that "stores processing programs for executing a variety of concrete processings in the exposure function and playback function and control programs for controlling drivings of the above-mentioned members of the

digital camera.” Niikawa, ¶[0096].

74. The general controller also includes an “image synthesizer” that reads the images from memory 126 and positions them so that the patterns in the images can be synthesized accurately to obtain a higher quality image. Niikawa, ¶¶[0003], [0111], [0139].

75. Specifically, image synthesizer 159 “performs a synthesis process of data of two images with different exposure amounts that have been captured in the gradation control processing mode. In this synthesis processes, positioning (positioning process) is performed between two images, and a process for generating an actual synthesized image (image synthesis process) by adding these at an appropriate adding ratio is performed[.]” Niikawa, ¶[0104].

76. The general controller 150 includes programs for controlling camera functions and the components of the digital camera 1. Niikawa, ¶[0096]. Based on the optical conditions of the lens, such as focal length and f-number, the general controller 150 selects a “correction table” with inverse correction coefficients from shading ROM 153 to send to the shading corrector. *Id.*, ¶¶[0082]-[0084], [0108].

77. Niikawa describes that “[w]hen a subject is photographed by using an image pickup device such as CCD in an image processing apparatus such as digital camera equipped with an imaging lens, a phenomenon that the level of image data decreases with the distance from the center of the image to the periphery, so-called

‘shading’ occurs.” Niikawa, ¶[0056]; *see also id.*, ¶[0060] (“Furthermore, in the case of using the same digital camera and the same imaging lens, the influence of shading varies with the focal length and the amount of exposure light.”).

78. As mentioned above, I understand from counsel that for prior art to be relevant in an obviousness analysis, it must be “analogous” to the patent being considered (here the ’339 Patent). To be analogous, it must be either (1) in the same field of endeavor or (2) reasonably pertinent to the problem the inventor was solving. Here, Niikawa is analogous on both fronts.

79. First, Niikawa is in the same field of endeavor as the ’339 Patent because it describes in-camera aberration corrections. The ’339 Patent describes the field as including “imaging systems” that include “electronic methods to optimize optical processing” and applies to photography. ’339 Patent, 1:16-34. By describing electronic aberration corrections within a digital camera, Niikawa conveys that it is in the same field as the ’339 Patent.

80. Second, Niikawa is reasonably pertinent to the problem to be solved by the ’339 Patent: correcting image aberrations in-camera. For example, the ’339 Patent states that “[t]he present system provides in-camera digital corrections to both optical and digital aberrations.” ’339 Patent, 8:3-6. Niikawa also provides in-camera digital corrections to aberrations by providing shading correction and then the synthesis of a single image from two separate images, thus improving image quality.

Niikawa, Abstract; *see also id.*, ¶[0003].

81. The '339 Patent also discloses “curvature of field” as one example of an optical aberration, which “manifest[s] as the reduced corner exposure of vignetting.” '339 Patent, 10:51-56; *see also id.*, claim 7. The '339 Patent further describes the correction associated with “curvature of field,” which “identifie[s] the degree of light fall-off for each specific lens and adjusts the brighter areas in the center of the lens by the appropriate exposure compensation.” *Id.*, 10:59-65.

82. A POSA would have understood that shading correction described in Niikawa and the vignetting correction described in the '339 Patent are two different terms for the same thing.

2. Steinberg (Ex-1028)

83. Steinberg discloses a digital camera with a red eye filter for “detecting a region within a captured image indicative of a red eye phenomenon . . . based upon a comparison of the captured image and a reference image.” Steinberg, Abstract; *see also id.*, ¶[0012] (“In the embodiment the filter detects said region indicative of a red-eye phenomenon by identifying a region in the captured image at least having a color indicative of a red-eye phenomenon and comparing said identified region with the corresponding region in the reference image”).

84. To perform this comparison of a captured image with one or more reference images, Steinberg uses software executed by a digital signal processor

(DSP) to (1) compare images—at least one taken without a flash and one taken with a flash, (2) identify suspected red eye in the image, and (3) correct the red eye by modifying pixel values. Steinberg, ¶¶[0030]–[0032].

85. Specifically, Steinberg explains:

The processor 120, in response to a user input at 122, such as half pressing a shutter button (pre-capture mode 32), initiates and controls the digital photographic process. Ambient light exposure is determined using light sensor 40 in order to automatically determine if a flash is to be used. ... If a flash is to be used, processor 120 causes the flash means 70 to generate a photographic flash in substantial coincidence with the recording of the image by image capture means 60 upon full depression of the shutter button....The image recorded by image capture means 60 is stored in image store means 80 which may comprise computer memory such a dynamic random access memory or a non-volatile memory....A temporary storage space 82 is used to store one or plurality of the preview images and be part of the image store means 80 or a separate component.

Steinberg, ¶[0029].

86. Steinberg discloses that the red eye filter 90 “analyzes the stored image

for characteristics of red-eye and, if found, modifies the image and removes the red-eye phenomenon from the image.” Steinberg, ¶[0030].

87. As mentioned above, I understand from counsel that for prior art to be relevant in an obviousness analysis, it must be “analogous” to the patent being considered (here the ’339 Patent). To be analogous, it must be either (1) in the same field of endeavor or (2) reasonably pertinent to the problem the inventor was solving. Here, Steinberg is analogous on both fronts.

88. First, Steinberg is in the same field of endeavor as the ’339 Patent, *i.e.*, the field including “imaging systems” that include “electronic methods to optimize optical processing” and applies to photography. ’339 Patent, 1:16-34. For example, Steinberg describes digital signal processing techniques, such as red eye correction, for imaging systems like digital cameras. *Compare* ’339 Patent, 38:59 (“red eye”) *with* Steinberg, ¶[0002].

89. Second, Steinberg is reasonably pertinent to the problem to be solved in the ’339 Patent. First, I note that claim 7 of the ’339 Patent identifies (claims) one example of an aberration correction as being “red-eye.” ’339 Patent, 38:59. Steinberg is directed to correcting for red eye using an in-camera aberration correction technique as I explained above. Steinberg, ¶[0002]. Thus, both the ’339 Patent and Steinberg are pertinent to the problem of correcting for red eye using in-camera techniques.

B. Claims 6, 7, and 10 would have been obvious over Niikawa and Steinberg

1. How and why a POSA would combine teachings from Steinberg with Niikawa

90. Niikawa's camera includes a flash, as was conventional in many digital cameras at the time. Niikawa, ¶¶[0068], [0088]. This would have immediately alerted the POSA to the fact that when the Niikawa flash was used to capture an image, red eye effect would have been a problem that the designer needed to address. This was a well-known and understood problem in flash photography as I have explained above. *See supra* § VI.D. A POSA would have found it highly desirable to have a way to correct for red eye—and preferably would have wanted to avoid the pre-flash solutions that I mentioned above, and which are discussed in the literature, as having their own problems. A review of Niikawa shows that Niikawa does not describe any techniques for removing red eye. Thus, a POSA would have sought out options to include within Niikawa for removing undesirable red eye from the resulting captured images.

91. This search for known red eye removal techniques would have led a POSA to Steinberg, which describes an effective way to remove red eye without the need for a pre-flash. Steinberg, ¶¶[0004]-[0005].

92. Given the known problems with using pre-flash, Steinberg discloses a “method of better tools for eliminating red-eye phenomenon within, for example, a

digital camera having a flash unit without the distraction of a pre-flash.” Steinberg, ¶[0006].

93. A POSA would have had a motivation to incorporate Steinberg’s red eye removal techniques, which did not employ pre-flash, into Niikawa’s digital camera to remove red eye, thus correcting a known problem with a camera like Niikawa’s.

94. As explained further above, Steinberg discloses a procedure for correcting red eye in an image by comparing “preview images” with a captured image to determine whether the captured image exhibits red eye. Steinberg, Abstract (detecting red eye “based upon a comparison of the captured image and a reference image of nominally the same scene taken without flash”).

95. In order to incorporate Steinberg’s red eye removal techniques into Niikawa’s digital camera, a POSA would have understood that several modifications to Niikawa’s camera were required. Those modifications, explained in further detail below, include (1) incorporating Steinberg’s red eye filtration algorithms into Niikawa’s software; (2) storing Steinberg’s red eye filtration algorithms in Niikawa’s ROM; (3) storing images in a database in Niikawa’s general controller; and (4) using a digital signal processor to implement Steinberg’s red eye filtration programs.

96. To apply filtration to Steinberg’s preview and captured images,

Niikawa's camera would need to have storage for those images so that the images may be accessed and compared to detect red eye.

97. For instance, Steinberg discloses two memory storage locations (80 and 82) for storing preview images and captured images for comparison as shown below in Figure 1:

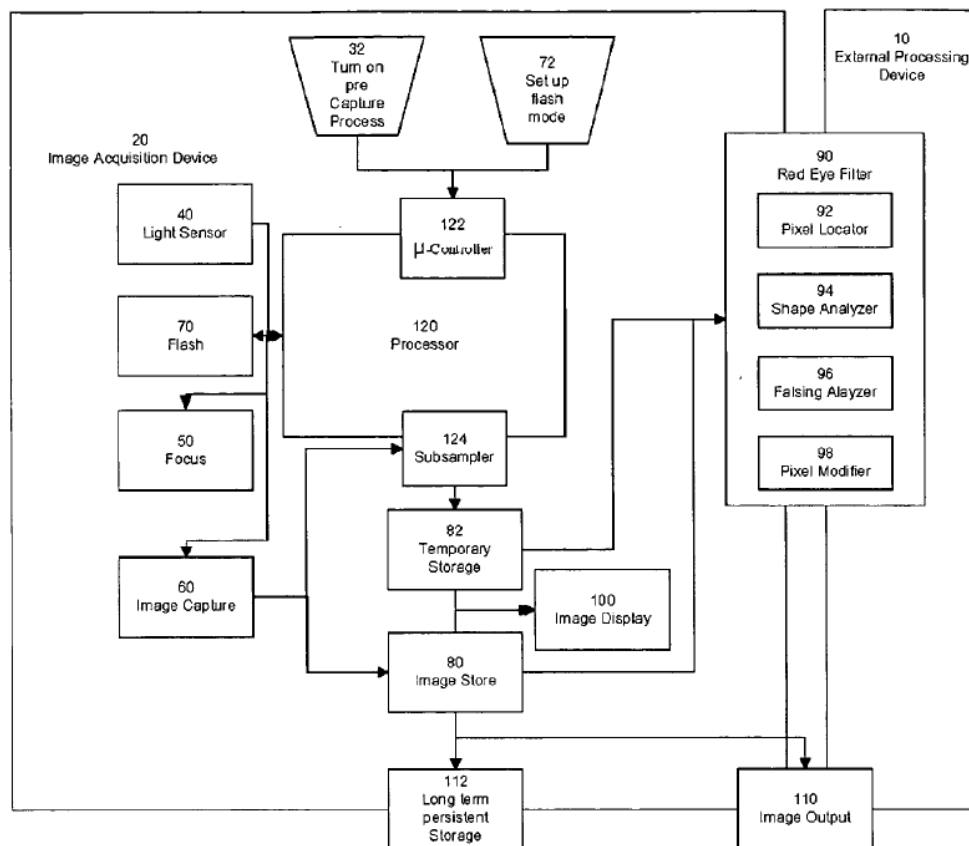


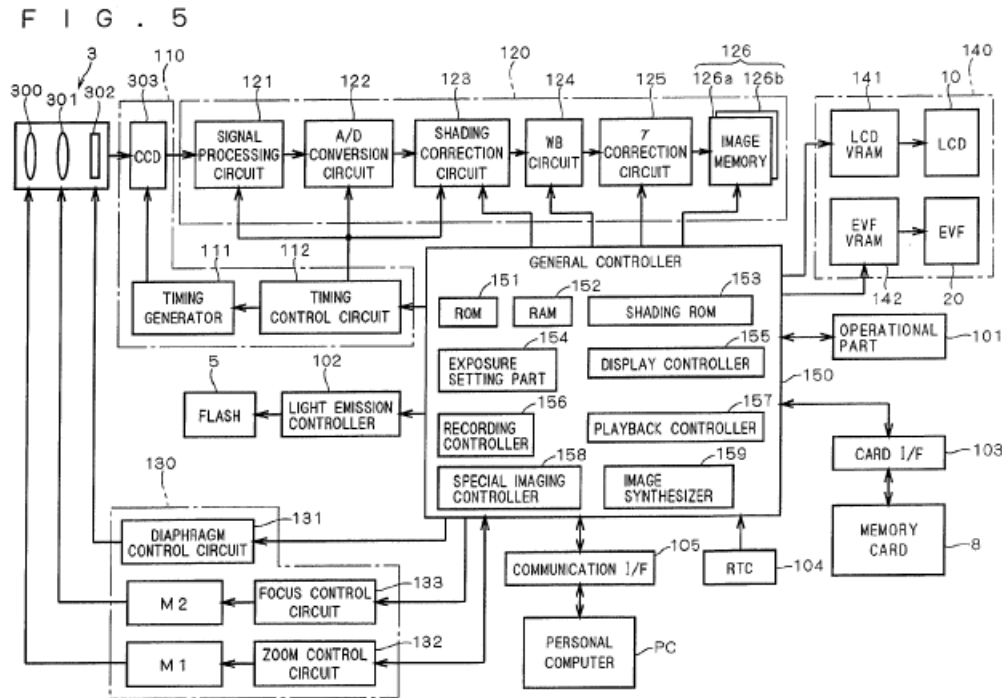
Figure 1

98. Steinberg explains that temporary storage 82 “is used to store one or plurality of the preview images” and “image store” 80 can “comprise computer

memory such as a dynamic random access memory or a non-volatile memory” and can store the captured image. Steinberg, ¶¶[0029]. Steinberg also explains that “temporary storage space 82 . . . [can] be part of the image store means 80 or a separate component.” *Id.*, ¶[0029].

99. Steinberg further explains that the “filter 90 analyzes the stored image for characteristics of red-eye and, if found, modifies the image and removes the red-eye phenomenon from the image.” Steinberg, ¶[0030]. The “stored image” analyzed by filter 90 come from either “the full resolution image storage 80 as well as one or a plurality of preview images from the temporary storage 82.” *Id.*

100. In order to implement Steinberg’s red eye filtration, Niikawa’s digital camera 1 would have needed storage for images to be analyzed. Niikawa already discloses various locations for image storage. For instance, Niikawa explains that the digital camera 1 comprises “an image memory capable of storing a plurality of images; and a controller for controlling the image memory to store a shading-corrected image that has been subjected to a shading correction by the shading corrector.” Niikawa, ¶[0016]. The “memory” disclosed in Niikawa includes memory card 8 and image memory 126. *Id.*, ¶¶[0066], [0079]. These storage locations are depicted in Figure 5, below.



101. Niikawa explains that “centralized control of the exposure function and playback function” are performed by general controller 150. Niikawa, ¶[0095]. General controller 150 also generates “a control signal for photographing a subject, a reference clock, a timing control signal (synchronous clock) for processing an image signal outputted from the CCD 303 at the signal processor 120.” *Id.*, ¶[0078]. And, “general controller 150 performs selection of correction table from the shading ROM 153 in accordance with the optical condition such as focal length and f-number at the time of imaging.” *Id.*, ¶[0084]. Therefore, Niikawa discloses that general controller performs image processing functions, such as image synthesis and storage.

102. Since captured images are processed in Niikawa’s general controller 150 before they are stored in memory, a POSA would have been motivated to store

the reference and captured images in storage within general controller for ease of access, retrieval, and processing. This merely uses Niikawa's general controller 150 for its stated purpose – “centralized control” of the functions performed by Niikawa. Niikawa, ¶[0095].

103. Neither Niikawa nor Steinberg explain the structure of the location in which the preview images would have been stored. Therefore, a POSA would have needed to select from a number of known image storage techniques. One known image storage technique was to use a database, which a POSA would have include within Niikawa's general controller 150, which performed “centralized control” of Niikawa's processes. Niikawa, ¶[0095].

104. It was known in the art to store images in a database. For example, Walker is directed to acquiring and storing images in a digital camera. *See* Walker (Ex-1037), Abstract. Walker discloses that the memory “preferably stores a plurality of databases.” *Id.*, ¶[0110]; *see also id.*, ¶¶[0112], [0164], [0182]. Walker further discloses that the memory may store an “image database.” *Id.*, ¶[0147]; *see also id.* ¶¶[0167], [0172].

105. I understand from counsel that “applying a known technique to a known device (method, or product) ready for improvement to yield predictable results” is an indication that a claim limitation is obvious. I conclude based on the discussion above that this rationale applies here. Storing images in a database was a known

technique for image storage and retrieval. A POSA would have understood the convenience of storing images for processing by Steinberg's red eye filtration in a database contained within the same general controller that performed the image processing. *Supra* §X.B.1.

106. Additionally, in order to incorporate Steinberg's red eye removal techniques into Niikawa's digital camera, a POSA would have understood that Niikawa's system software would need to store Steinberg's red eye filtration algorithms.

107. A POSA would understand that Niikawa's ROM 151 stored software to control various camera functions. Niikawa, ¶[0096]. It would have been obvious to a POSA to also store Steinberg's red eye filtration algorithms. Steinberg, ¶[0032]. Storage of the red eye filtration algorithms in Niikawa's ROM 151, where other camera software is stored, would have allowed Niikawa's camera to remove red eye from images, which was a highly undesirable image aberration.

108. I have been informed by counsel that "combining prior art elements according to known methods to yield predictable results" indicates that a claim is obvious. Here, a POSA would have also found it obvious to store Steinberg's red eye filtration algorithms in Niikawa's ROM 151 alongside other programs and algorithms because it would have merely used Niikawa's ROM 151 for its stated purpose, which was to house programs for use by the camera hardware. Niikawa,

¶[0096].

109. Further, once Steinberg's software was stored in Niikawa's ROM 151, a POSA would have understood that a structure was needed to load and execute Steinberg's software. It would have been obvious to use a processor, including a digital signal processor, for this purpose. Indeed, Steinberg itself explains that "many of the processes implemented in the digital camera may be implemented in or controlled by software operating in a . . . digital signal processor (DSP)," which is generically referred to as a "processor" in Figure 1. Steinberg, ¶[0029].

110. A POSA would have also been motivated to use a DSP in place of a general purpose processor because DSPs were more efficient than general purpose processors for use in embedded systems when it came to performing specific arithmetic operations on images. For instance, Sandler disclosed in 1989 that "DSP devices definitely exhibit a clear advantage on a performance per processor basis, and in the embedded real time systems, they will prove the more cost effective." Sandler (Ex-1038) at p.1535. Sandler also disclosed that image processing was of "great importance as a sub-class of DSP operations." *Id.*, p.1532.

111. Therefore, based on the teachings of Steinberg itself, along with the knowledge of a POSA from other references such as Sandler, a POSA would have known to execute the functionality of Steinberg's red eye filter 90 using a DSP in Niikawa's general controller 150.

112. I understand from counsel that a “teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention” is an indication that a claim limitation is obvious. For the reasons stated above, Steinberg itself provides the requisite teaching, suggestion, or motivation to use a DSP to implement red eye filtration in Niikawa’s system, and this rationale is also supported by references like Sandler. *Supra* §X.B.1.

113. A POSA would have expected to succeed in combining Niikawa and Steinberg (referred to throughout as the “Niikawa-Steinberg system”). The Niikawa-Steinberg system would have compared image files in a database management system using system software and an integrated circuit (general controller 150) to identify red eye in the image file, conveyed filtration algorithms from general controller 150 (specifically, ROM 151) to the DSP within the general controller, and correct for red eye by using the DSP to apply the Steinberg digital filtration algorithms as recited in limitations [6D], [6E], and [6F].

114. Success would be expected because Niikawa and Steinberg both use digital camera hardware that, as described above, was well known, and indeed, ubiquitous, by the 2006 earliest effective filing date of the ’339 Patent. *Supra* §§VI.B-C. The digital camera hardware included lenses, CCDs, A/D converters, integrated circuits, DSPs, and various image correction algorithms. *See, e.g.,*

Niikawa, Abstract (plurality of correction tables), ¶¶[0067] (zoom lens 300, focus lens 301, imaging lens 3), [0069] (CCD 303), [0078] (A/D conversion circuit), [0079] (digital signal processing); *see also* Steinberg, ¶[0029] (CCD, light sensor 40, microprocessor, central processing unit, controller, digital signal processor, and/or an application specific integrated circuit).

115. I understand from counsel that “use of known technique to improve similar devices (methods, or products) in the same way” is an indication of obviousness. Based on the discussion above, I conclude that this rationale applies to the Niikawa-Steinberg system to correct red eye in Niikawa’s digital camera system. *Supra* §X.B.1.

2. Independent Claim 6

a. Element [6pre]

“A digital imaging system for correcting optical image aberrations comprising:”

116. I was instructed by counsel to assume that the preamble is a limitation. I have done so. Niikawa discloses a digital imaging system that performs optical image aberration correction. *See, e.g.*, Niikawa, Abstract, Fig. 5.

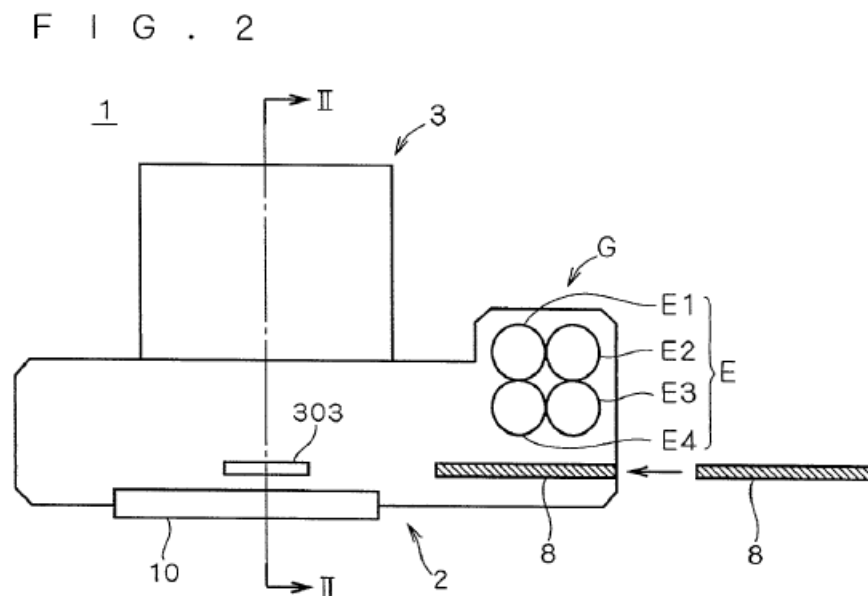
b. Element [6A]

“a digital camera mechanism, an optical lens mechanism, a digital sensor, an integrated circuit, a digital signal processor, system software, a database management system and a memory storage sub-system;”

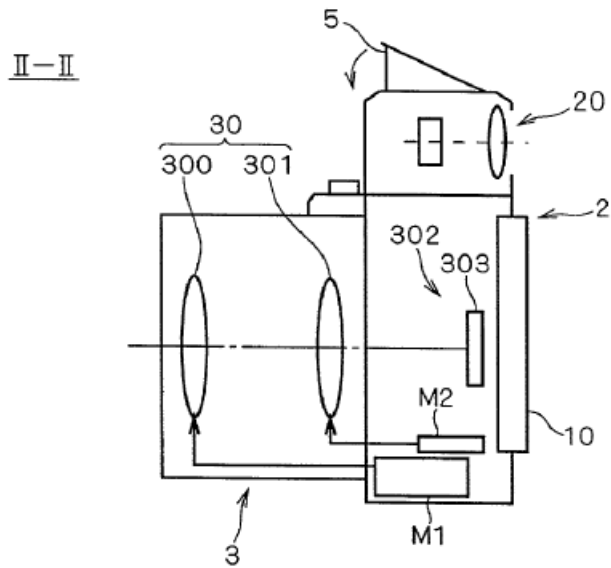
117. Element [6A] recites “a digital camera mechanism, an optical lens mechanism, a digital sensor, a microprocessor, a digital signal processor, system software, a database management system and a memory storage sub-system.” I explain how each of the sub-elements is disclosed by Niikawa and/or Steinberg in turn.

[6A-1] “digital camera mechanism”

118. Niikawa discloses digital camera 1. Niikawa, Abstract, ¶[0065], Figs. 2-4. Different views of digital camera 1 are depicted in Figures 2 and 3. *Id.*, ¶[0065].

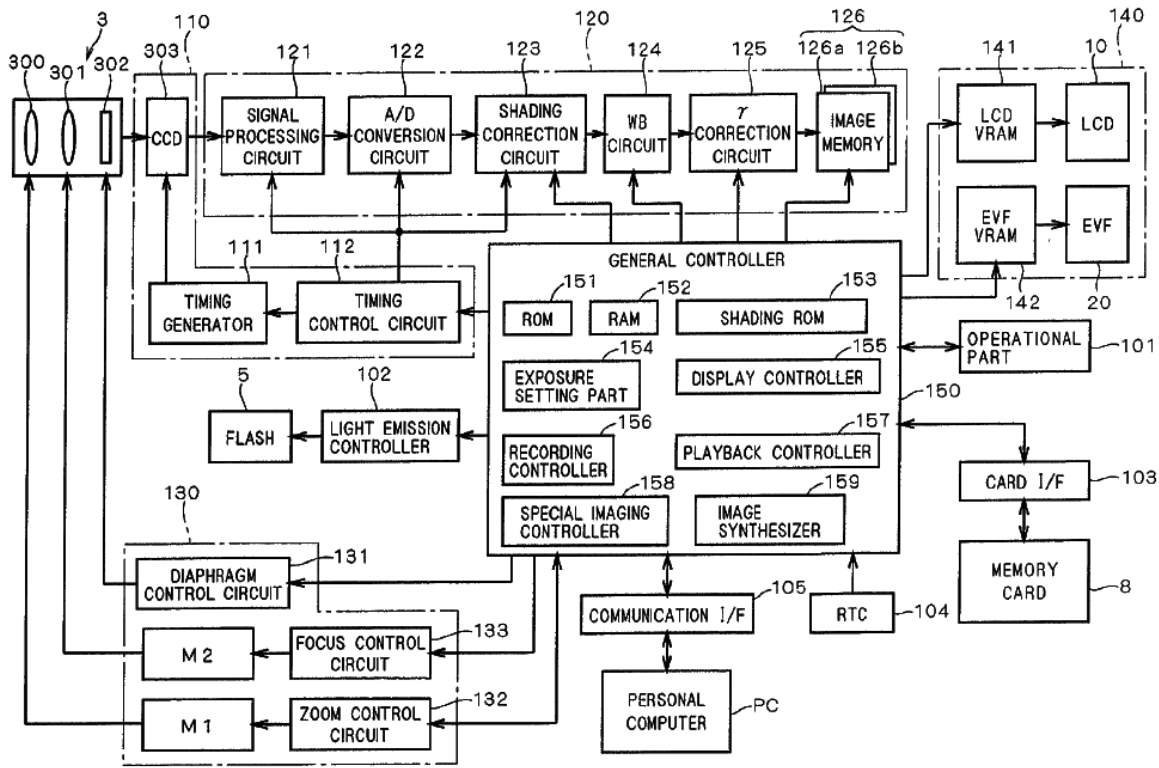


F I G . 3



119. Additionally, Figure 5 is a “schematic block diagram showing an internal configuration of the digital camera 1.” Niikawa, ¶¶[0029], [0075], Fig. 5.

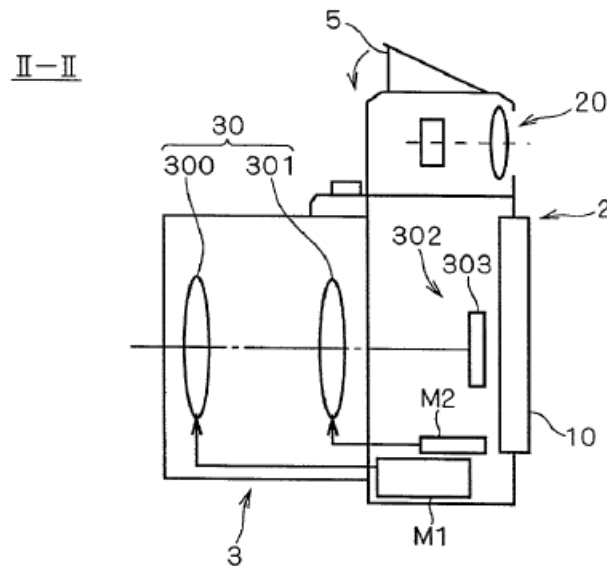
F I G . 5



[6A-2] “optical lens mechanism”

120. Niikawa discloses that digital camera 1 contains “imaging lens 3 which is a zoom lens having a macro function comprises a lens group 30 including a zoom lens 300 and a focus lens 301.” Niikawa, ¶[0067]. This lens mechanism is depicted in Figure 3. *Id.*

F I G . 3



[6A-3] “digital sensor”

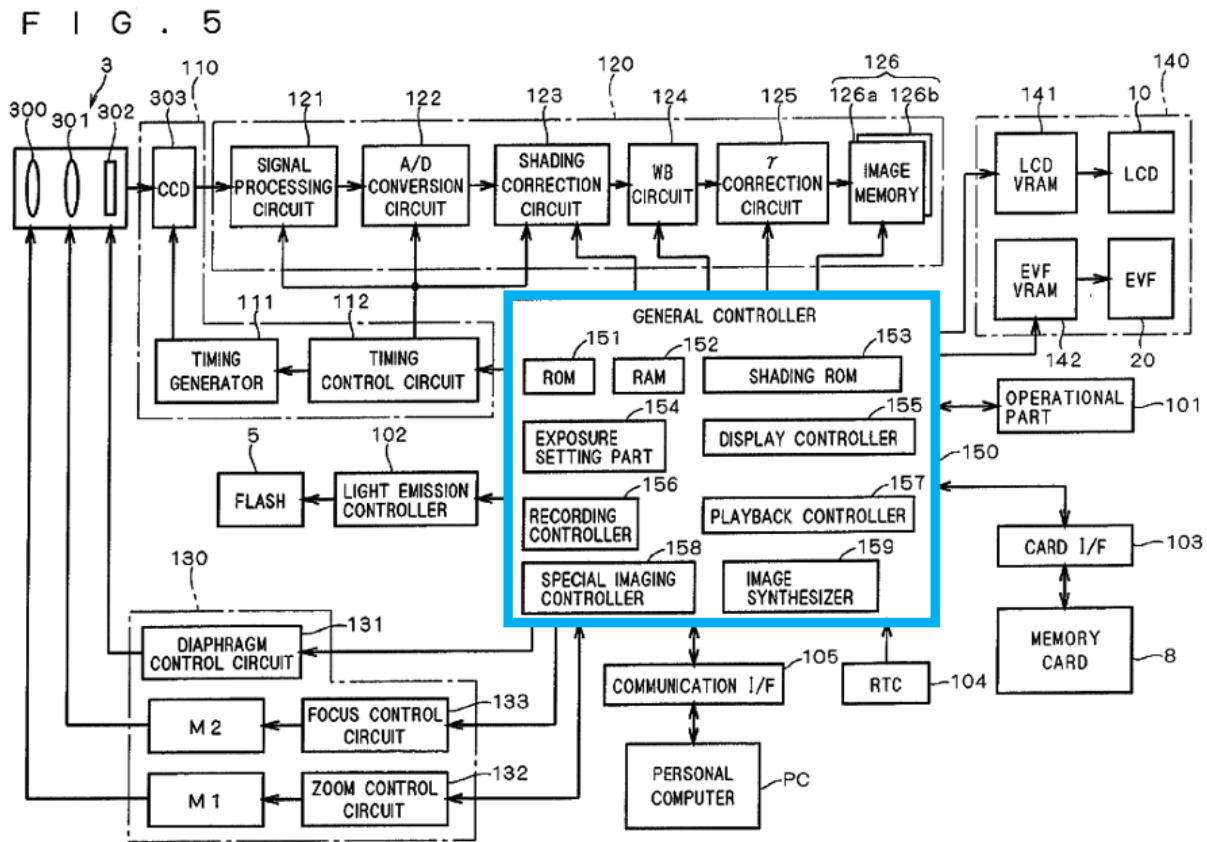
121. Niikawa discloses that digital camera 1 has CCD 303, which is a type of digital sensor. Niikawa, ¶[0077]. Specifically, “CCD 303 receives the light of the subject light source for a predetermined exposure time based on a drive control signal inputted from the timing generator 111 to convert it to an image signal, and outputs the image signal to a signal processor 120 by using a readout control signal inputted from the timing generator.” *Id.*; see also *id.* at claim 8 (“an image sensor for acquiring a first image and a second image for the same subject in different timings”).

122. The '339 Patent likewise discloses that a CCD is a digital sensor. '339 Patent, 2:48-51.

[6A-4] “integrated circuit”

123. Niikawa discloses that digital camera 1 includes general controller 150, which “is implemented by a microcomputer and performs centralized control of the exposure function and playback function.” Niikawa, ¶[0095]. A POSA would have understood that a microcomputer is an integrated circuit for the reasons I outlined above in Section VI.B. with respect to, for example, Endo, DeLuca, Safai, Anderson, Hung, Amerson, and Battles, which discussed substitutes and corollaries to integrated circuits.

124. General controller 150 is outlined in blue in the image below:



125. If it is argued that Niikawa does not disclose that general controller 150 is an integrated circuit, a POSA would have been motivated to implement Niikawa's general controller 150 as an integrated circuit.

126. In fact, the claims of the '339 Patent itself makes clear that microprocessors, application specific integrated circuits (ASICs), or systems on a chip (SoCs) are examples of integrated circuits. '339 Patent, 39:8-11 ("The system of claim 6: wherein the integrated circuit may be a microprocessor, an application specific integrated circuit or a system on a chip.").

127. As I described above in Sections VI.B–C. (discussing Endo, DeLuca, Safai, Anderson, Hung, Amerson, Battles, and the TI White Paper), a POSA knew that digital cameras used integrated circuits to perform various camera-related functionality and that ASICs and microprocessors are examples of integrated circuits.

128. Therefore, implementing Niikawa's general controller 150 as an integrated circuit would have been obvious to a POSA because it would have used conventional technologies (*e.g.*, a microprocessor) for its intended purpose of executing the functions of Niikawa's code.

129. A POSA would have integrated Niikawa's general controller in order to enable higher speeds, which is one of Niikawa's goals. Niikawa, ¶[0122] ("[S]ince the shading correction is implemented by a special hardware circuit, it is possible to

perform the shading correction with relatively high speed.”); *see also* Moore (Ex-1034), p.84 (“[S]hrinking dimensions on an integrated structure makes it possible to operate the structure at higher speed for the same power per unit area.”).

130. It was also well known to a POSA that implementing electronics in the form of an integrated circuit offers further advantages, including reduction in size of electronic components, power consumption, and cost. The consequences of integration electronics were well understood by this time, as described by Moore in a reprint of an article from 1965. Moore describes that even in 1965, integrated circuits were known to be highly reliable. Moore (Ex-1034), pp.82-83. Moore explains that integrated circuits made “electronic techniques more generally available throughout all of society” and had the “principal advantages” of being of lower cost and “greatly simplified design.” *Id.*, p.83.

131. A POSA would have therefore been motivated to implement Niikawa’s general controller 150 as an integrated circuit. Linden describes that electronics manufacturers were integrating “large-scale electronic systems on a single chip” as part of efforts toward miniaturization. Linden (Ex-1032), pp.545-546; *see also id.*, Abstract (“Miniaturization has spurred ever-increasing on-chip integration in the semiconductor industry so that large-scale electronic systems can now be put on a single chip.”).

132. A POSA knew that integrating electronics into integrated circuits

allowed for more power on more reliable, smaller, and cheaper devices. *See, e.g.*, Moore, pp.82-83. Thus, even if Niikawa's general controller was not an integrated circuit, it would have been obvious and advantageous to a POSA to implement it as such. Doing so would have simply substituted Niikawa's general controller 150 for a more powerful, more reliable, smaller, and cheaper component.

133. A POSA would have expected to succeed in implementing Niikawa's general controller 150 as an integrated circuit because it was known that integrated circuits were often used to perform various operations in digital cameras. For example, DeLuca disclosed that "many of the processes implemented in the digital camera may be implemented in or controlled by software operating in a microcomputer (μ C) or digital signal processor (DSP) and/or an application specific integrated circuit (ASIC)." DeLuca (Ex-1033) at 5:46-51. Indeed, DeLuca specifically disclosed that a red eye filter process preferably operates within software within a [μ C] or DSP and processes an image stored in image store 80." *Id.* at 11:1-3.

134. I understand from counsel that "simple substitution of one known element for another to obtain predictable results" is an indication of obviousness. For the reasons stated above, I conclude that this rationale applies here in implementing Niikawa's general controller 150 as an integrated circuit. *Supra* §X.B.1.

[6A-5] “digital signal processor”

135. The claimed digital signal processor would have been obvious over Niikawa in view of Steinberg. To make this declaration easier to read, I discuss this DSP limitation in connection with Limitation [6E] below. The discussion in Limitation [6E] below contains a description of how the claimed DSP would have been obvious in the combined Niikawa-Steinberg system.

[6A-6] “system software”

136. Niikawa discloses that ROM 151 on general controller 150 “stores processing programs for executing a variety of concrete processings in the exposure function and the playback function and control programs for controlling drivings of the above-mentioned members of the digital camera 1[.]” Niikawa, ¶[0096], *see also id.*, ¶[0215] (“The information of the focal length and the f-number to be used for selecting the correction table is acquired from the tag information stored in the ROM 151.”).

137. The ’339 Patent describes “processing software” as “stored in either a microprocessor or an ASIC.” ’339 Patent, 21:67-22:1. A POSA would have understood that “processing software” and “system software” are synonymous, and therefore that the programs stored in Niikawa’s ROM 151 were system software.

[6A-7] “database management system”

138. Niikawa discloses that general controller 150 accesses and retrieves

correction tables stored in shading ROM 153, *i.e.*, the database. Niikawa, ¶¶[0082]-[0086]. Specifically, Niikawa discloses:

A plurality of correction tables for different parameters which are the optical conditions such as focal length and f-number at the time of imaging are prepared and stored in a shading ROM 153 provided in the general controller 150. The general controller 150 performs selection of correction table from the shading ROM 153 in accordance with the optical condition such as focal length and f-number at the time of imaging. Therefore, the shading correction circuit 123 can perform a shading correction in accordance with the optical condition.

Id., ¶[0084].

139. An example of a correction table is depicted in Figure 7 of Niikawa:

F I G . 7

1.5	1.5	1.5	1.5	..	1.5
1.5	1.5	1.4	1.4	..	1.5
1.5	1.4	1.4	1.3	..	1.5
1.5	1.4	1.3	1.3	..	1.5
.	.	.	.	..	.
1.5	1.5	1.5	1.5	..	1.5

140. Niikawa discloses:

As shown in FIG. 7, the correction table has 1,920,000 correction coefficients (actually, inverses of correction coefficients) for corresponding to the respective 1,920,000 pixels of 1,600 pixels×1,200 pixels of the CCD 303. Each correction coefficient corresponds to the rate of decrease in level of each pixel data shown in FIG. 1, and the inverse of the correction coefficient is held in the correction table in advance. When each pixel shown in the curve of FIG. 1 is multiplied by the inverse of the correction coefficient, the curve is converted to a straight line in which the levels of image data are constantly 1.

That is, by subjecting every pixel data to the multiplication by the inverse of the correction coefficient (coefficient process), the shading can be corrected. In the case where overflow occurs in this multiplication process, the level of the image data is set at the maximum value of 1023.

Niikawa, ¶[0083].

141. A POSA would have understood that a database often includes information stored in tables, such that the correction tables disclosed in Niikawa are an example of a database. *See, e.g.*, Bestgen (Ex-1014), 2:8-12 (“a database may be viewed as one or more tables of information”); Cesare (Ex-1015), 1:36-39 (“Data records in a computer database are maintained in tables, which are a collection of rows all having the same columns.”).

142. Niikawa also discloses a database management system (“DBMS”) as described in the ’339 Patent to the extent a DBMS is determined not to be limited to a database.

143. The DBMS comprises the correction tables organized in shading ROM 153 and general controller 150, and the programs stored in ROM 151. Those programs comprise a DBMS at least because they are software that retrieves image correction data associated with focal length and f-number at the time of imaging from the database among other things, discussed below (*e.g.*, Limitation [6D]). *See*,

e.g., Niikawa, ¶¶[0082]-[0086] Figs. 5, 7-8; *see also id.*, ¶[0096] (“The general controller 150 has a ROM 151 which stores processing programs for executing a variety of concrete processings in the exposure function and the playback function and control programs for controlling drivings of the above-mentioned members of the digital camera 1[.]”).

[6A-8] “memory storage sub-system”

144. Niikawa discloses that digital camera 1 has image memory 126 and memory card 8. Niikawa, ¶[0066] (“memory card 8 . . . record[s] a captured image”); *see also id.*, ¶[0087] (“The image memory 126 is a memory for temporarily storing image data for which image processing has been completed. The image memory 126 has two memory areas, concretely a first memory 126 a and a second memory 126 b so as to be capable of storing image data of two frames.”); ¶[0100] (“Then, the recording controller 156 generates an image file in which tag information is attached to compressed captured image and thumbnail image, and records the image file onto the memory card 8”); Fig. 8.

c. Element [6B]

“wherein the optical lens mechanism is a zoom lens or fixed focal length lens;”

145. Niikawa discloses that digital camera 1 contains “imaging lens 3 which is a zoom lens having a macro function comprises a lens group 30 including a zoom lens 300 and a focus lens 301.” Niikawa, ¶[0067].

146. Niikawa discloses that “imaging lens 3 . . . is a zoom lens[.]” Niikawa, ¶[0067]. Niikawa’s zoom lens 300 can also be adjusted. *Id.*, ¶[0084] (“A plurality of correction tables for different parameters which are the optical conditions such as focal length and f-number at the time of imaging are prepared and stored in a shading ROM 153 provided in the general controller 150.”).

147. Using a zoom lens was therefore well known as described in Niikawa itself. Niikawa, ¶[0067].

d. Element [6C]

“wherein the image data file is forwarded from the digital sensor to storage in memory;”

148. Niikawa discloses that digital camera 1 has image memory 126 and memory card 8 . Niikawa, ¶¶[00766], [0087], Fig. 5. After image processing, the image is stored in image memory 126 before being sent to memory card 8 as a file. *Id.*, ¶[0100]. For example, Niikawa explains:

The recording controller 156 executes a recording process. In the normal exposure mode, the recording controller 156 reads out the image data that has been temporarily stored in the image memory 126 after an instruction for exposure is made, and performs predetermined processes based on the JPEG system such as two-dimensional DCT conversion and Huffman coding to generate image

data for use recording as captured image data. Furthermore, a thumbnail image is generated by reading out the image data every 8 pixels in each of the vertical and the horizontal directions from the image memory 126 to the RAM 152. Moreover, tag information relating to the captured image data which to be recorded in association with these captured image data is generated. Then, the recording controller 156 generates an image file in which tag information is attached to compressed captured image and thumbnail image, and records the image file onto the memory card 8.

Id., ¶[0100].

e. Element [6D]

“wherein at least one optical and/or digital aberration in the image file are identified by comparing image files in the database management system by using the system software and the integrated circuit;”

149. For the reasons described in detail above, this limitation would have been obvious over Niikawa and Steinberg. *Supra* §X.B.1.

150. Dependent claim 7 of the '339 Patent identifies “red eye” as an example of an optical aberration. '339 Patent, 38:55-60.

151. Steinberg teaches that red eye (*i.e.*, an aberration in the image file) is identified by comparing image files as recited in Limitation [6D]. For example,

Steinberg discloses:

According to this embodiment, after the alignment step 540 the following steps 592-1 a and 592-1 b analyse both images $I'(x,y)$ and $P''(x,y)$ for the presence of pixels having a color indicative of red-eye (592-1 a), for example in the manner of DeLuca, and then identifies clusters of contiguous red pixels so detected (592-1 b). This is known as segmentation and is more fully described in US Pat. Appn. 2002/0176623, which is hereby incorporated by reference.

Now, each region (cluster) with red content in the acquired image $I'(x,y)$, step 592-2, is compared with the corresponding region in the aligned preview image $P''(x,y)$. The regions will need to be prepared, 592-4, as previously described in relation to block 596-4 of FIG. 5-a. If the regions are red in both cases, 592-6=YES, the region will not be marked as red-eye, no action will be taken and the process will continue to the next suspected region, 592-3. If the region is red in the acquired image $I'(x,y)$ while the corresponding region is not red in the preview image $P''(x,y)$, 592-6=NO, then the region will be marked as suspected red-eye, 592-8.

Steinberg, ¶¶[0064]-[0065].

152. As explained above, a POSA implementing Steinberg's red eye correction in Niikawa's digital camera would have temporarily stored Steinberg's preview and captured images in a database management system. Those stored images would have been retrieved and compared using software stored in Niikawa's general controller 150. *Supra* §X.B.1.

153. As also explained above, Niikawa's DBMS comprises the correction tables organized in shading ROM 153 and general controller 150, and the programs stored in ROM 151. *See* discussion of Limitation [6A-7].

154. Niikawa's ROM 151, which is part of the database management system, stores a variety of "processing" and "control" programs. Niikawa, ¶[0096]. As described in detail above, it would have been obvious to a POSA that Niikawa's ROM 151 would have included Steinberg's red eye filtration programs. *Supra* §X.B.1.; *see also* Steinberg, ¶[0029] ("[M]any of the processes implemented in the digital camera may be implemented in or controlled by software"). *Supra* §X.B.1.

155. Therefore, and as described in more detail above, it would have been obvious to install Steinberg's algorithms with other camera control software in Niikawa's ROM 151 in implementing the Niikawa-Steinberg system. *Supra* §X.B.1. This is because Niikawa stores programs implementing camera functionality in

ROM 151.

156. Therefore, it would have been obvious to a POSA implementing Steinberg's red eye correction in Niikawa's digital camera to store Steinberg's programs and images in a database management system.

157. A POSA would also have used Niikawa's system software and the integrated circuit in general controller 150 and ROM 151 to compare the preview and captured image to identify red eye. That is because Steinberg teaches that camera functionality is implemented using software executed by hardware and image capture and red eye correction are implemented using system software. Steinberg, ¶¶[0029], [0032].

158. A POSA would have therefore used an integrated circuit and system software to perform Steinberg's comparison of captured and preview images to identify whether red eye is present in a captured image so that it may be corrected based on the express teaches of Niikawa and Steinberg.

f. Element [6A-5]

“a digital signal processor;”

Element [6E]

“wherein the at least one filtration algorithms required to correct the at least one optical and/or digital aberration are sent from the integrated circuit to the digital signal processor;”

159. A POSA would have found it obvious to send Steinberg's red eye

filtration algorithm from the integrated circuit to a digital signal processor under the construction discussed above. *Supra* §IX.

160. More specifically, it would have been obvious to send the red eye filtration algorithm (*i.e.*, the at least one filtration algorithms required to correct the at least one optical and/or digital aberration) from Niikawa's ROM 151, which stores programs in Niikawa's integrated circuit, to Steinberg's DSP, which implements Steinberg's red eye identification and correction techniques within Niikawa's general controller 150.

161. As further explained above, Steinberg describes software that compares preview images with captured images to identify and correct red eye. *Supra* §X.A.2.; *see also* Steinberg, ¶[0032].

162. Steinberg discloses that "many of the processes implemented in the digital camera may be implemented in or controlled by software operating in a . . . digital signal processor (DSP)." Steinberg, ¶[0029].

163. As further described above in the discussion of Sandler, DSPs were known as early as 1989 to be better for use in embedded systems than general purpose microprocessors. *Supra* §X.B.1. (discussing Sandler, pp.1532, 1535).

164. Steinberg's DSP is given the generic name "processor." Steinberg, ¶[0029] ("It can be appreciated that many of the processes implemented in the digital camera may be implemented in or controlled by software operating in a

microprocessor (μ Proc), central processing unit (CPU), controller, digital signal processor (DSP) and/or an application specific integrated circuit (ASIC), collectively depicted as block 120 and termed as “processor.”). This depicted in Figure 1 of Steinberg:

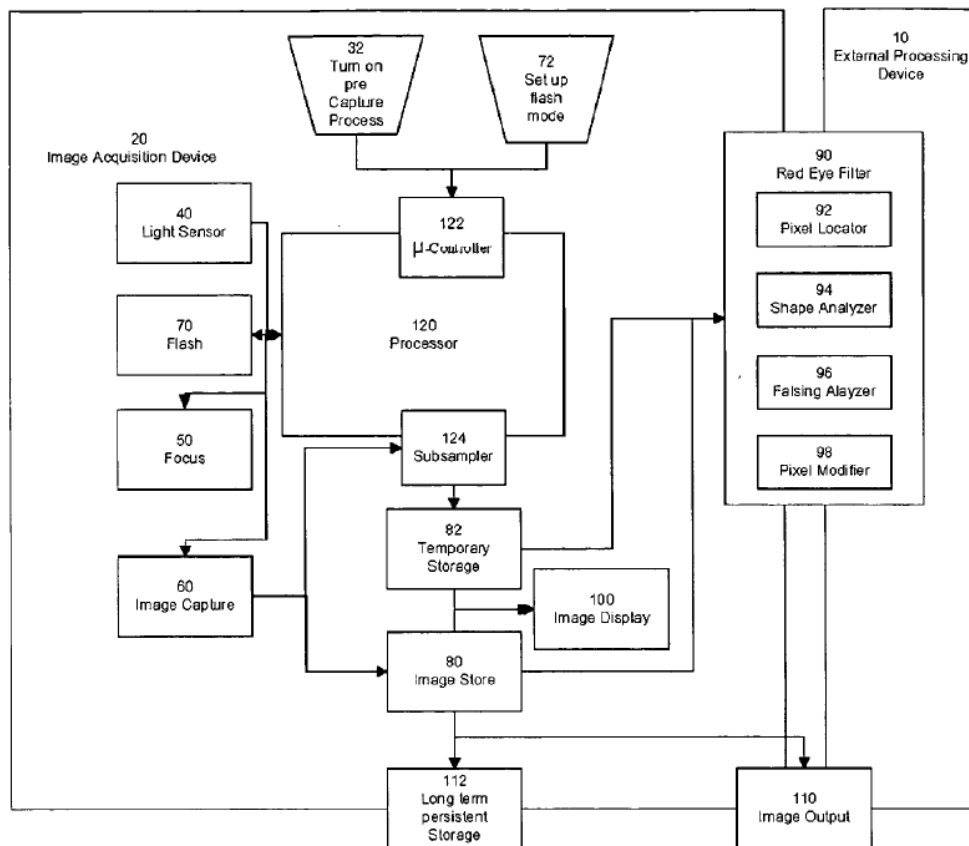


Figure 1

165. Steinberg’s DSP would have naturally been included in Niikawa’s general controller by a POSA combining the references for the reasons described above. *Supra* §X.B.1.

166. In this setup, Steinberg's red eye correction software (stored in Niikawa's ROM 151 in general controller 150) would have been sent to Steinberg's DSP (also in general controller 150) to remove detected red eye.

167. As described further above, a POSA would have been motivated to include Steinberg's red eye correction in the programs stored in Niikawa's general controller 150 because it would have used a known technique to improve a similar device in the same way. *Supra* §X.B.1. Counsel informs me that this is a rationale that supports a conclusion of obviousness, and I conclude that it applies here. Including Steinberg's red eye correction software in Niikawa's general controller 150 would allow Niikawa's digital camera to identify an algorithm from a database to apply for correction of an optical aberration. *Supra* §X.B.1.

g. Element [6F]

“wherein the at least one optical and/or digital aberration from the optical lens mechanism are corrected by using the digital signal processor to apply digital filtration algorithm; and”

168. Claim 7 of the '339 Patent discloses that “red eye” is an example of an optical aberration. '339 Patent at 38:55-60. The combined Niikawa-Steinberg system would have been configured to correct such red eye because, as explained above in connection with Limitation [6E], using Steinberg's DSP and executing Steinberg's “red-eye filter 90” in Niikawa's general controller 150 would have

allowed the DSP to apply Steinberg's digital filtration algorithm to perform red eye correction. *See* discussion of Limitation [6E] above.

h. Element [6G]

“wherein the modified digital file consisting of the digital data optimized from the at least one aberration that are corrected from the original optical image is stored in memory.”

169. Niikawa discloses that digital camera 1 has memory card 8, which is where modified digital files are stored after image processing . Niikawa, ¶¶[0016], [0032], [0066], [0087], [0092], [0095], [0100]-[0102], Figs. 2, 5, 8.

170. A POSA using the combined Niikawa-Steinberg system would have stored the file that included the corrections to the original optical image applied by Niikawa and the red eye removal of Steinberg (*i.e.*, the “modified digital file”) in memory card 8. That is because both Niikawa and Steinberg store modified digital files in a similar memory. *Compare* Niikawa, ¶[0101] (“FIG. 8 is a view showing a recording method of image file onto the memory card 8.”) *with* Steinberg, ¶[0030] (“The modified image may be . . . saved on a persistent storage 112 which can be . . . removeable storage such as CF card, SD card or the like . . .”).

3. Claim 7

“The system of claim 6: wherein the optical aberrations include spherical, comatic, lens distortion, astigmatism, chromatic aberrations, curvature of field, pin cushion, barrel distortion, scattered light, red eye, dust and/or flare types of optical aberrations.”

171. As explained in my discussion of claim 6, the combined Niikawa-Steinberg system would have corrected aberrations including “red eye.” *See* discussion of Limitations [6D]-[6G]; *see also supra* §X.B.1. Therefore, claim 7 would have been obvious for the same reasons discussed above for claim 6.

4. Claim 10

“The system of claim 6: wherein the digital signal processor applies color filtration to the image file.”

172. Claim 10 would have been obvious over Niikawa in view of Steinberg. As explained above, in the combined Niikawa-Steinberg system, Steinberg’s DSP would be used to perform the red eye filtration techniques described by Steinberg. *Supra* § X.B.1.

173. A POSA would have understood that the red eye filtration performed by Steinberg is a “color filtration.” Steinberg, ¶[0064] (“[A]fter the alignment step 540 the following steps 592-1 a and 592-1 b analyse both images $I'(x,y)$ and $P(x,y)$ for the presence of pixels having a color indicative of red-eye (592-1 a), ... and then identifies clusters of contiguous red pixels so detected (592-1 b)”).

174. Steinberg explains that images are compared to detect regions with suspected red eye:

If the regions are red in both cases, 592-6=YES, the region will not be marked as red-eye, no action will be taken and the process will continue to the next

suspected region, 592-3. If the region is red in the acquired image $I'(x,y)$ while the corresponding region is not red in the preview image $P''(x,y)$, 592-6=NO, then the region will be marked as suspected red-eye, 592-8.

Steinberg, ¶[0065].

175. After this comparison and identification, a pixel modifier is used to modify “the color of the pixels within a region indicative of a red-eye phenomenon.” Steinberg, ¶[0014]; *see also id.*, ¶¶[0054] (explaining how the pixel modifier of U.S. Patent No. 6,407,777 to DeLuca (Ex-1039) is incorporated by reference); [0067] (“In the embodiments of the invention, in the comparison stages, 592-6 and 596-6 the pixel values do not necessarily have to be compared with red but may alternatively or additionally be compared with other values such as yellow, white, pink, brown or other color indicative of a red-eye phenomenon, or to a range of values, to accommodate other flash related eye artefacts that are not purely red.”).

176. Because Steinberg modifies the color of pixels to perform red eye filtration, it applies color filtration to the image file.

C. Secondary Considerations of Non-Obviousness

177. I am unaware of any applicable secondary considerations of non-obviousness. None were identified or asserted during prosecution. *See generally* Ex-1002.

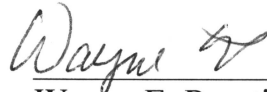
XI. Conclusion

178. For the reasons set forth above, in my opinion, all limitations of all claims of the '339 Patent are disclosed by the prior art (and combinations thereof) cited herein. And, I have explained that a POSA would have found it obvious to combine Niikawa and Steinberg to arrive at the combined Niikawa-Steinberg system having all of the features of claims 6, 7, and 10 using only routine skill to arrive at only predictable, desirable results. Therefore, claims 6, 7, and 10 would have been obvious.

Declaration of Wayne Prentice
U.S. Patent No. 8,451,339

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the results of these proceedings.

Executed on February 21, 2025 in Honeoye Falls, New York.



Wayne E. Prentice